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UTILITY PATENT APPLICATION TRANSMITTAL

(Only for new nonprovisional applications under 37 CFR 1.53(b))

Attorney Docket No. 04860.P2207XD Total Pages 3

First Named Inventor or Application Identifier Anne Jones, et al.

Express Mail Label No. EL 431 891 983 US

ADDRESS TO: **Assistant Commissioner for Patents**
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APPLICATION ELEMENTS

See MPEP chapter 600 concerning utility patent application contents.

1. X Fee Transmittal Form
(Submit an original, and a duplicate for fee processing)

2. X Specification (Total Pages 90)
(preferred arrangement set forth below)
- Descriptive Title of the Invention
- Cross References to Related Applications
- Statement Regarding Fed sponsored R & D
- Reference to Microfiche Appendix
- Background of the Invention
- Brief Summary of the Invention
- Brief Description of the Drawings (if filed)
- Detailed Description
- Claims
- Abstract of the Disclosure

3. X Drawings(s) (35 USC 113) (Total Sheets 14)

4. X Oath or Declaration (Total Pages 3 sets of 5 pages each [15 pgs total])

   a. ___ Newly Executed (Original or Copy)

   b. X Copy from a Prior Application (37 CFR 1.63(d))
   (for Continuation/Divisional with Box 17 completed) **(Note Box 5 below)**

   i. ___ DELETIONS OF INVENTOR(S) Signed statement attached deleting inventor(s) named in the prior application, see 37 CFR 1.63(d)(2) and 1.33(b).

5. ____ Incorporation By Reference (useable if Box 4b is checked)
The entire disclosure of the prior application, from which a copy of the oath or declaration is supplied under Box 4b, is considered as being part of the disclosure of the accompanying application and is hereby incorporated by reference therein.

6. ____ Microfiche Computer Program (Appendix)

7. ____ Nucleotide and/or Amino Acid Sequence Submission
(if applicable, all necessary)
   a. ___ Computer Readable Copy
   b. ___ Paper Copy (identical to computer copy)
   c. ___ Statement verifying identity of above copies

ACCOMPANYING APPLICATION PARTS

8. ____ Assignment Papers (cover sheet & documents(s))
9. ____ a. 37 CFR 3.73(b) Statement (where there is an assignee)
____ b. Power of Attorney
10. ____ English Translation Document (if applicable)
11. ____ a. Information Disclosure Statement (IDS)/PTO-1449
____ b. Copies of IDS Citations
12. X Preliminary Amendment
13. X Return Receipt Postcard (MPEP 503) (Should be specifically itemized)
14. ____ a. Small Entity Statement(s)
b. Statement filed in prior application, Status still proper and desired
15. ____ Certified Copy of Priority Document(s) (if foreign priority is claimed)

16. X Other: Copy of postcard with Express Mail Certificate of Mailing
Submission of Formal Drawings transmittal with 14 sheets of formal drawings

17. **If a CONTINUING APPLICATION,** check appropriate box and supply the requisite information:
___ Continuation X Divisional ____ Continuation-in-part (CIP)
of prior application No: 09/140,173 filed 8-25-98

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Serial/Patent No.: *** Filing/Issue Date: December 23, 1999
Client: Apple Computer, Inc.
Title: METHOD AND APPARATUS FOR MEDIA DATA TRANSMISSION

BSTZ File No.: 04860.P2207XD Atty/Secty Initials: JCS/clt
Date Mailed: 12-23-99 Docket Due Date: ***

The following has been received in the U.S. Patent & Trademark Office on the date stamped hereon:

- ☐ Amendment/Response (____ pgs.)
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- ☐ Application - Utility (____ pgs., with cover and abstract)
- ☐ Application - Rule 1.53(b) Continuation (____ pgs.)
- ■ Application - Rule 1.53(b) Divisional (3 pgs.)
- ☐ Application - Rule 1.53(b) CIP (____ pgs.)
- ☐ Application - Rule 1.53(d) CPA Transmittal (____ pgs.)
- ☐ Application - Design (____ pgs.)
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- ☐ Application - Provisional (____ pgs.)
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- ☐ Disclosure Docs & Ltr & Copy of Inventor's Signed Letter (____ pgs)
- ■ Drawings: 14 # of sheets includes 15 figures

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- ☐ Issue Fee Transmittal
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- ☐ Petition for _____
- ■ Postcard
- ☐ Power of Attorney (____ pgs.)
- ■ Preliminary Amendment (10 pgs.)
- ☐ Reply Brief (____ pgs.)
- ☐ Response to Notice of Missing Parts
- ☐ Small Entity Declaration for Indep. Inventor/Small Business
- ■ Transmittal Letter, in duplicate
- ■ Fee Transmittal, in duplicate 2 pages

- ■ Check No. 32427 Amt: $1030.00
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■ Other: copy of prior application serial no. 09/140,173 filed 8/25/98 (90 pages) with signed declaration and drawings; also Submission of Formal Drawings Transmittal (1 page)

Atty. Docket No.: 4860.P2207XD

Patent

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In Re Application of:

Jones et al.

Serial No.: To be determined

Filed: December 23, 1999

For: **Method and Apparatus for Media Data Transmission**

which is a divisional of

Serial No.: 09/140,173

Filed: August 25, 1998

Art Unit: To be determined

Examiner: To be determined

Assistant Commissioner for Patents
Washington, D.C. 20231

PRELIMINARY AMENDMENT

Dear Sir:

Applicants respectfully request that the above-identified application be preliminarily amended as follows:

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Connie Thayer
(Signature of person mailing paper or fee)

12-23-99
(Date signed)

IN THE CLAIMS

Please cancel claims 1-56 without prejudice.

Please add the following new claims:

57. (New) A method implemented by a digital processing system for processing media data, said method comprising:

retrieving from a digital storage system a set of data which indicates how to transmit a time related sequence of media data according to a transmission protocol, wherein said set of data is a time related sequence of data associated with and separate from said time related sequence of media data.

58. (New) A method as in claim 57 further comprising:

transmitting packets of data representing said time related sequence of media data according to said transmission protocol.

59. (New) A method as in claim 57 wherein for each of said packets, said set of data refers to data in at least one of a sequence of image data or a sequence of audio data associated with said time related sequence of media data.

60. (New) A method as in claim 57 wherein said method further comprises packetizing said time related sequence of media data according to said set of data.

61. (New) A machine readable medium containing executable program instructions, which when executed on a digital processing system cause the digital processing system to perform a method comprising:

retrieving a set of data which indicates how to transmit a time related sequence of media data according to a transmission protocol wherein said set of data is a time related sequence of data associated with and separate from said time related sequence of media data.

62. (New) The machine readable medium as in claim 61, said method further comprising:

transmitting data representative of said time related sequence of media data according to said set of data.

63. (New) The machine readable medium of claim 61, wherein said set of data is stored as a track of indicating data.

64. (New) The machine readable medium as in claim 61 wherein said transmission protocol comprises a packet data protocol.

65. (New) The machine readable medium of claim 61, wherein said method further comprises:

determining a format of said time related sequence of media data;

packetizing said time related sequence of media data according to said set of data;

wherein said transmission protocol is used to transmit said time related sequence of media data which has said format and wherein said packetizing uses said format and said protocol to packetize said time related sequence of media data.

66. (New) The machine readable medium of claim 65, wherein the method further comprises:

transmitting packets of data representing said time related sequence of media data according to said transmission protocol.

67. (New) The machine readable medium of claim 66, wherein for each of said packets, said set of data refers to data in at least one of a sequence

of image data or a sequence of audio data associated with said time related sequence of media data.

68. (New) An apparatus comprising:

a port configured to receive a set of data associated with transmission of a time related sequence of media data according to a transmission protocol, wherein said set of data is a time related sequence of data associated with and separate from said time related sequence of media data;

a processing unit coupled to said port to receive said set of data, said processing unit packetizing said time related sequence of media data according to said set of data.

69. (New) The apparatus of claim 68, further comprising a transmitter coupled to said processing unit, said transmitter for transmitting packets of data representing said time related sequence of media data according to said transmission protocol.

70. (New) The apparatus of claim 69, wherein for each of said packets, said set of data refers to data in at least one of a sequence of image

data or a sequence of audio data associated with said time related sequence of media data.

71. (New) An apparatus for processing media data, said apparatus comprising:

a means for retrieving a set of data which indicates how to transmit a time related sequence of media data according to a transmission protocol, wherein said set of data is a time related sequence of data associated with and separate from said time related sequence of media data; and

a means for packetizing said time related sequence of media data according to said set of data.

72. (New) The apparatus of claim 71, further comprising:

a means for transmitting packets of data representing said time related sequence of media data.

73. (New) The apparatus of claim 72, wherein for each of said packets, said set of data refers to data in at least one of a sequence of image data or a sequence of audio data associated with said time related sequence of media data.

74. (New) A method implemented by a digital processing system for processing media data, said method comprising:

retrieving a first time related sequence of data to indicate how to transmit a second time related sequence of data according to a transmission protocol, wherein said second time related sequence of data is associated with time-based media, and wherein said first time related sequence of data is associated with said second time related sequence of data; and

packetizing said second time related sequence of data according to said first time related sequence of data.

75. (New) A method as in claim 74, further comprising:

transmitting packets of data representing said second time related sequence of data according to said transmission protocol.

76. (New) A method as in claim 75, wherein for each of said packets, said first time related sequence of data refers to at least one of a sequence of image data or a sequence of audio data associated with said second time related sequence of data.

77. (New) A method as in claim 76, wherein said second time related sequence of data is stored on a read-only memory (ROM).

78. (New) A machine readable medium containing executable program instructions, which when executed on a digital processing system cause the digital processing system to perform a method comprising:

retrieving a set of data which indicates how to transmit a time related sequence of media data according to a transmission protocol wherein said set of data is a time related sequence of data associated with said time related sequence of media data.

79. (New) The machine readable medium as in claim 78, said method further comprising:

transmitting data representative of said time related sequence of media data according to said set of data.

80. (New) The machine readable medium of claim 78, wherein said set of data is stored as a track of indicating data.

81. (New) The machine readable medium as in claim 78 wherein said transmission protocol comprises a packet data protocol.

82. (New) The machine readable medium of claim 78, wherein said method further comprises:

determining a format of said time related sequence of media data;

packetizing said time related sequence of media data according to said set of data;

wherein said transmission protocol is used to transmit said time related sequence of media data which has said format and wherein said packetizing uses said format and said protocol to packetize said time related sequence of media data.

83. (New) The machine readable medium of claim 82, wherein the method further comprises:

transmitting packets of data representing said time related sequence of media data according to said transmission protocol.

84. (New) The machine readable medium of claim 83, wherein for each of said packets, said set of data refers to data in at least one of a sequence

of image data or a sequence of audio data associated with said time related sequence of media data.

REMARKS

This application is being filed as a divisional of application serial number 09/140,173, filed August 25, 1998. Claims pending in the instant application are numbered 57-84. Applicants respectfully request consideration of the instant divisional application as amended.

If there are any additional charges, please charge Deposit Account No. 02-2666.

Respectfully submitted,

BLAKELY, SOKOLOFF, TAYLOR & ZAFMAN

Date: 12/23, 1999

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04860.P2207

UNITED STATES PATENT APPLICATION

FOR

METHOD AND APPARATUS FOR MEDIA DATA TRANSMISSION

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METHOD AND APPARATUS FOR MEDIA DATA TRANSMISSION

FIELD OF THE INVENTION

The present invention relates to methods and apparatuses for preparing time related sequences of media data for transmission, and more particularly to packetized transmission of such media data.

INTRODUCTION AND BACKGROUND

There are various different file structures used today to store time-based media: audio formats such as AIFF, video formats such as AVI, and streaming formats such as RealMedia. One reason that such file structures are different is their different focus and applicability. Some of these formats are sufficiently relatively widely accepted, broad in their application, and somewhat simple to implement, and thus, may be used not only for content delivery but also as interchange formats. Foremost among these general formats is the QuickTime file format. It is used today in the majority of web sites serving time-based data; in the majority of authoring environments, including professional ones; and on the majority of multimedia CDROM titles.

The QuickTime media layer supports the efficient display and management of general multimedia data, with an emphasis on time-based material (video, audio, etc.). The media layer uses the QuickTime file format as the storage and interchange format for media information. The architectural capabilities of the layer are generally broader than the existing implementations, and the file format is capable of representing more information than is currently demanded by the existing QuickTime implementations.

In contrast to formats such as AVI, which were generally designed to support *local* random access of synchronized media, QuickTime allows systems to manage the data, relationships and timing of a general multimedia presentation. In particular, the QuickTime file format has structures to represent the temporal behavior of general time-based streams, a concept which covers the time-based emission of network packets, as well as the time-based local presentation of multimedia data.

The existing QuickTime file format is publicly described by Apple Computer in the May 1996 File format specification, which may be found at the QuickTime site, <http://.www.apple.com/quicktime>.

One aspect of the QuickTime file format is the concept that the physical structure of media data (the layout in disk records) is independent of, and described by, a logical structure for the file. The file is fully described by a set of "movie" meta-data. This meta-data provides declarative, structural and temporal information about the actual media data.

The media data may be in the same file as the description data, (the "movie" meta-data), or in other file(s). A movie structured into one file is commonly called "flat", and is self-contained. Non-flat movies can be structured to reference some, or all, of the media data in other files.

As such, the format is generally suited for optimization in different applications. For example, when editing (compositing), data need not be rewritten as edits are applied and media is re-ordered; the meta-data file may be extended and temporal mapping information adjusted. When edits are complete, the relevant media data and meta-data may be rewritten into a single, interleaved, and optimized file for

local or network access. Both the structured and the optimized files are valid QuickTime files, and both may be inspected, played, and reworked.

The use of structured ("non-flat") files enables the same basic media data to be used and re-used in any number of presentations. This same advantage applies when serving, as will be seen below.

In both editing and serving, this also permits a number of other files to be treated as part of a movie without copying the media data. Thus editing and serving may be done directly from files such as Sun Microsystem's "au" audio format or the AVI video format, greatly extending the utility of these formats.

The QuickTime file is divided into a set of objects, called atoms. Each object starts with an atom header, which declares its size and type:

```
class Atom {
      int(32)      size;
      char         type[4];
      byte         contents[];
}
```

The size is in bytes, including the size and type header fields. The type field is four characters (usually printable), to permit easy documentation and identification. The data in an object after the type field may be fields, a sequence of contained objects, or both.

A file therefore is simply a sequence of objects:

```
class File {
      Atom[];
}
```

The two important top-level objects are the media-data (mdat) and the meta-data (moov).

The media-data object(s) contain the actual media (for example, sequences of sound samples). Their format is not constrained by the file format; they are not usually objects. Their format is described in the meta-data, not by any declarations physically contiguous with them. So, for example, in a movie consisting solely of motion-JPEG, JPEG frames are stored contiguously in the media data with no intervening extra headers. The media data within the media data objects is logically divided into chunks; however, there are no explicit chunk markers within the media data.

When the QuickTime file references media data in other files, it is not required that these 'secondary' files be formatted according to the QuickTime specification, since such media data files may be formatted as if they were the contents of a media object. Since the QuickTime format does not necessarily require any headers or other information physically contiguous with the media data, it is possible for the media data to be files which contain 'foreign' headers (e.g. UNIX ".au" files, or AVI files) and for the QuickTime meta-data to contain the appropriate declarative information and reference the media data in the 'foreign' file. In this way the QuickTime file format can be used to update, without copying, existing bodies of material in disparate formats. The QuickTime file format is both an established format and is able to work with, include, and thereby bring forward, other established formats.

Free space (e.g. deleted by an editing operation) can also be described by an object. Software reading a file that includes free space objects should ignore such free space objects, as well as objects at any level which it does not understand. This permits extension of the file at virtually any level by introducing new objects.

The primary meta-data is the movie object. A QuickTime file has exactly one movie object which is typically at the beginning or end of the file, to permit its easy location:

```
class Movie {
      int(32)      size;
      char         type[4] = 'moov';
      MovieHeader mh;
      contents     Atom[];
}
```

The movie header provides basic information about the overall presentation (its creation date, overall timescale, and so on). In the sequence of contained objects there is typically at least one track, which describes temporally presented data.

```
class Track {
      int(32)      size;
      char         type[4] = 'trak';
      TrackHeader th;
      contents     Atom[];
}
```

The track header provides relatively basic information about the track (its ID, timescale, and so on). Objects contained in the track might be references to other tracks (e.g. for complex compositing), or edit lists. In this sequence of contained objects there may be a media object, which describes the media which is presented when the track is played.

The media object contains declarations relating to the presentation required by the track (e.g. that it is sampled audio, or MIDI, or orientation information for a 3Dscene). The type of track is declared by its handler:

```
class handler {
      int(32)     size;
      char        type[4] = 'hdlr';
      int(8)      version;
      bit(24)     flags;
      char        handlertype[4];    -- mhlr for media handlers
      char        handlersubtype[4] -- vide for video, soun for
audio
      char        manufacturer[4];
      bit(32)     handlerflags;
      bit(32)     handlerflagsmask;
      string      componentname;
}
```

Within the media information there is likewise a handler declaration for the data handler (which fetches media data), and a data information declaration, which defines which files contain the media data for the associated track. By using this declaration, movies may be built which span several files.

At the lowest level, a sample table is used which relates the temporal aspect of the track to the data stored in the file:

```
class sampletable {
      int(32)     size;
      char        type[4] = 'stbl';
      sampledescription sd;
      timetosample      tts;
      syncsampletable   syncs;
      sampletochunk     stoc;
      samplesize        ssize;
      chunkoffset       coffset;
      shadowsync        ssync;
}
```

The sample description contains information about the media (e.g. the compression formats used in video). The time-to-sample table relates time in the track, to the sample (by index) which should be displayed at that time. The sync

sample table declares which of these are sync (key) samples, not dependent on other samples.

The sample-to-chunk object declares how to find the media data for a given sample, and its description given its index:

```
class sampletochunk {
      int(32)     size;
      char        type[4] = 'stsc';
      int(8)      version;
      bits(24)    flags;
      int(32)     entrycount;
      for (int i=0; i<entrycount; i++) {
            int(32)     firstchunk;
            int(32)     samplesperchunk;
            int(32)     sampledescriptionindex;
      }
}
```

The sample size table indicates the size of each sample. The chunkoffset table indicates the offset into the containing file of the start of each chunk.

Walking the above-described structure to find the appropriate data to display for a given time is fairly straightforward, generally involving indexing and adding. Using the sync table, it is also possible to back-up to the preceding sync sample, and roll forward 'silently' accumulating deltas to a desired starting point.

Figure 1 shows the structure of a simple movie with one track. A similar diagram may be found in the QuickTime file format documentation, along with a detailed description of the fields of the various objects. QuickTime atoms (objects) are shown here with their type in a grey box, and a descriptive name above. This movie contains a single video track. The frames of video are in the same file, in a single chunk of data. It should be noted that the 'chunk' is a logical construct only; it is not an object. Inside the chunk are frames of video, typically stored in their native form. There are no required headers or fields in the video frames themselves.

Figure 2 is a diagram of a self-contained file with both an audio and a video track. Fewer of the atoms are shown here, for brevity; the pointers from the tracks into the media data are, of course, the usual sample table declarations, which include timing information.

The QuickTime file format has a number of advantages, including:

1) Scalability for size and bit-rates. The meta data is flexible, yet compact. This makes it suitable for small downloaded movies (e.g. on the Internet) as well as providing the basis for a number of high-end editing systems.

2) Physical structure is independent of the logical and temporal structure. This makes it possible to optimize the physical structure differently depending on the use the file will have. In particular, it means that a single file format is suitable for authoring and editing; downloading or placing on CDROMs; and for streaming.

3) The file format has proven capable of handling a very broad variety of codec types and track types, including many not known at the time the format was designed. This proven ability to evolve in an upwards-compatible fashion is fundamental to the success of a storage format.

Scalable, or layered, codecs can be handled in a number of ways in the QuickTime file format. For a streaming protocol which supports scalability, the samples may be tagged with the layer or bandwidth threshold to be met for transmitting the samples.

Tracks which form a set of alternatives (e.g. different natural language sound tracks) can be tagged so that only one is selected for playback. The same structure can be used to select alternatives for streaming (e.g. for language selection). This capability is described in further detail in the QuickTime file format.

When QuickTime displays a movie or track, the appropriate media handler accesses the media data for a particular time. The media handler must correctly

interpret the data stream to retrieve the requested data. For example, with respect to video media, the media handler typically traverses several atoms to find the location and size of a sample for a given media time. The media handler may perform the following:

1. Determine the time in the media time coordinate system.
2. Examine the time-to-sample atom to determine the sample number that contains the data for the specified time.
3. Scan the sample-to-chunk atom to discover which chunk contains the sample in question.
4. Extract the offset to the chunk from the chunk offset atom.
5. Find the offset within the chunk and the sample's size by using the sample size atom.

It is often desirable to transmit a QuickTime file or other types of time related sequences of media data over a data communication medium, which may be associated with a computer network (e.g. the Internet). In many computer networks, the data which is transmitted into the network should generally be in a packet form. Normally, time related sequences of media data are not in the proper packetized format for transmission over a network. For example, media data files in the QuickTime format are not in a packetized format. Thus, there exists a need to collect the data, sometimes referred to as streaming data, into packets for transmission over a network.

One prior approach to address the problem of transmitting time related sequences of media data over a network is to send the media file over the network using a network or transmission protocol, such as the Hypertext Transfer Protocol (HTTP). Thus, the media file itself is sent from one computer system over the network to another computer system. However, there may be no desire to retain the

media file at the receiving computing system. That is, when the media file is received and viewed or listened to at the receiving computer system, there may be no desire by the user of that receiving computer system to store a copy of the file, for example, if the receiving computing system is a network computer or a computer with low storage capacity.

Another alternative approach to solving the problem of how to collect data for transmission by packets over a network is to prepare a file which contains the network protocol data units in the file for a particular transmission protocol. In a sense, such a file may be considered a packetized file which is stored in essentially the same format as it will be transmitted according to the particular transmission protocol. Performing this operation generally involves storing the file in a packetized form for a particular network protocol at a particular data transmission rate and a particular media file format. Thus, for each different transmission protocol at a particular data transmission rate, the file will essentially be replicated in its packetized form. The fixed form of such files may restrict their applicability/compatibility and make it difficult to view such files locally. Thus, such an approach may greatly increase storage requirements in attempting to provide the file in various transmission protocols at various different data transmission rates. Moreover, each packetized file generated according to this alternative prior approach is generally limited to a particular media file format, and thus, other media file formats for the same media object (e.g. a digital movie) are typically packetized and stored on the sending computer system.

Yet another approach to solving the problem of how to stream time related sequences of media data is to perform the packetization of the media data when

required on the transmitting system according to the particular transmission protocol which is desired. This processing requires, in many cases, a relatively considerable amount of time, and thus, may slow the performance of the transmitting system.

Thus, it is desirable to provide an improved method and apparatus for transmitting time related sequences of media data.

SUMMARY OF THE INVENTION

The present invention provides methods and apparatuses for processing media data for transmission in a data communication medium. In one embodiment, a set of data indicates how to transmit a time related sequence of media data according to a transmission protocol. The set of data, according to one embodiment, includes a time related sequence of data which is associated with the time related sequence of media data. According to one aspect of the invention, the set of data may be utilized by a digital processing system to transmit the time related sequence of media data (e.g., by packets generated according to the transmission protocol and the set of data).

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 shows an example of the structure of a simple movie with one track in the prior art.

Figure 2 is an example of a self-contained movie file of the prior art.

Figure 3 is a flowchart showing one example of a method according to the present invention.

Figure 4 shows an example of a hint track of the present invention.

Figure 5 shows another example of a hint track of the present invention.

Figure 6 is a diagram of a network of computer systems in which media data may be exchanged and/or processed, according to one embodiment of the present invention.

Figure 7 is a block diagram of a digital processing system which may be used in accordance with one embodiment of the present invention.

Figure 8 is a block diagram of a system that utilizes hints to transfer media data, according to one embodiment of the invention.

Figure 9 is a block diagram of a system that utilizes hints to transfer media data, according to one embodiment of the invention.

Figure 10 is a flow diagram illustrating a method for generating hints for providing media data transmission, according to one embodiment of the invention.

Figure 11 is a flow diagram illustrating a method of processing media data received by a receiving system in accordance with hints, according to one embodiment of the invention.

Figure 12 is an example of a machine readable storage medium that may be accessed by a digital processing system, such as a generator, according to one embodiment of the invention.

Figure 13 is an example of a machine readable storage medium that may be accessed by a digital processing system, such as a server, according to one embodiment of the invention.

Figure 14 is an example of a machine readable storage medium that may be accessed by a digital processing system, such as a receiving system or other digital processing system, according to one embodiment of the invention.

Figure 15 is a diagram of a data storage and/or communication medium having stored/transported thereon media and hint information, according to one embodiment of the invention.

DETAILED DESCRIPTION

The present invention provides methods and apparatuses for allowing the transmission, and particularly the packetized transmission of time related sequences of media data, which may include, for example, video, audio, video and audio, etc., over a communication media, such as in a computer network.

In one embodiment of the present invention, a digital processing system creates a set of data for indicating how to transmit a time related sequence of media data according to a transmission protocol. Typically, this set of data is stored on a storage device coupled to the digital processing system. Further, this set of data is a time related sequence of data associated with the time related sequence of media data.

The present invention may be implemented entirely in executable computer program instructions which are stored on a computer readable media or may be implemented in a combination of software and hardware, or in certain embodiments, entirely in hardware. Typically, a server computer system coupled to a network will create the set of data, which may be referred to as a hint track and will store this hint track in a storage device which is coupled to the server computer system. When a client computer system requests a presentation (e.g. a viewing or listening or viewing and listening) of a media data file, the server system uses the hint track to determine how to packetize the media data for transmission to the client computer system. It will be appreciated that the present invention is generally applicable to time related sequences of media data, and that QuickTime is represented herein as one example of this general applicability. Thus, the invention should not necessarily be limited to QuickTime.

Figure 3 shows one example of a method according to the present invention. The method 300 shown in Figure 3 begins in step 301, in which the media file format for the particular media data which is desired to be transmitted is determined. In step 303, the particular transmission protocol or protocols which are desired to be used is also determined. However, steps 301 and 303 are optional, for example, in the case where the same media file format is always transmitted using the same transmission protocol.

In step 305, a digital processing system, such as a server computer system, creates and stores the hints for packetizing a time related sequence of media data in a media file. Alternatively, one computer system may create the hints and provide them to another system, such as a server computer system, which stores them for later use in a transmission process. The packetization allows the transmission over a network or communication media according to the desired transmission protocol which was determined in step 303. In one embodiment of the present invention, the hints are stored as a track of time related sequence of hints which refers to, but which in one embodiment, is separate from other tracks of media data. The track of hints, in one embodiment of the present invention, may be stored separately from the media data to which it refers. As such, the track of hints may be stored in a file which is distinct from another file containing the media data which is referred to by the track of hints, or the track of hints may be stored in a hint area in the file containing the media data which is separate and distinct from the data area containing the actual media data. In one embodiment of the invention, a hint track, or portion thereof, may be interpreted as executable instructions by the server, which executable instructions cause the server

to packetize a time related sequence of data, which is typically, but not necessarily, time-based media data. In one embodiment of the present invention, the hints are stored on the storage device which is coupled to the transmitting digital processing system.

In step 307, the data which is packetized according to the hints, is transmitted from a transmitting system, such as a server computer system, to a receiving system. This media data is transmitted by packetizing the media data according to the hints. In one alternative embodiment of the invention, the server computer system may decide not to use the hints and to send the media data by an alternative packetization process.

In step 309, the receiving system presents the media object which is represented by the media data. Typically, this presentation (which may be a viewing and listening of a media object or merely a viewing or merely a listening of the media object) is performed as the packetized data is received at the receiving system. The packetized data may, in one embodiment of the present invention, but need not be, stored on the receiving system. Thus the presentation of the data is ephemeral in the sense that once the presentation is over, there is no local copy at the receiving system. In another embodiment, presentation of the media object may take place on the server system subsequent to creating hints for the media data representing the media object. In one embodiment of the invention, the media data is not necessarily (re)formatted, copied, etc., for packetization according to hints.

In step 311, the receiving system may optionally reassemble the media file if the media file as received has been stored on the receiving system. It will be appreciated that the various steps of the method shown in Figure 3 may be performed

in a different order than the one shown and described above and/or some of the steps may be performed simultaneously. For example, in one embodiment, steps 309 and 311 are performed in parallel.

A particular implementation with QuickTime according to one embodiment of the present invention will now be described. In one embodiment of the present invention, a presentation which can be both viewed locally to the file (e.g., at a server, generator, etc.), and streamed over a network within a QuickTime movie is provided. In general, the streaming server (or another system) should have information about the data units to stream, their composition and timing. Since such information is typically temporal it may be described in tracks. A server may perform packetization and determine protocol information, for example, by using the same indexing operations as would be used to view a presentation.

The tracks which contain instructions for the servers are sometimes referred to as 'hint' tracks, since such tracks represent a set of data to direct the server in the process of forming and transmitting packets. The QuickTime file format supports streaming of media data over a network as well as local playback. The process of sending protocol data units is time-based, just like the display of time-based data, and is therefore suitably described by a time-based format. A QuickTime file or 'movie' which supports streaming includes information about the data units to stream. This information is included in additional tracks of the file called "hint" tracks.

Hint tracks contain instructions for a streaming server (or other digital processing system) which assist in the formation of packets. These instructions may contain immediate data for the server to send (e.g. header information) or reference

segments of the media data. In one embodiment of the present invention, instructions are encoded in the QuickTime file in the same way that editing or presentation information is encoded in a QuickTime file for local playback. Instead of editing or presentation information, information may be provided which may allow a server to packetize the media data in a manner suitable for streaming using a specific network transport.

In one embodiment of the present invention, the same media data is used in a QuickTime file which contains hints, whether it is for local playback, or streaming over a number of different transport types. Separate 'hint' tracks for different transport types may be included within the same file and the media may play over all such transport types without making any additional copies of the media itself. In addition, existing media may be made streamable by the addition of appropriate hint tracks for specific transports. According to one aspect of the invention, media data itself need not be recast or reformatted.

Therefore the samples in a hint track generally contain instructions to form packets. These instructions may contain immediate data for the server to send (e.g. header information) or reference segments of the media data in another track.

In one embodiment of the present invention, a three-level design is utilized such that:

1) The media data is represented as a set of network-independent tracks, which may be played, edited, and so on, as normal;

2) There is a common declaration and base structure for server hint tracks; this common format is protocol independent, but contains the declarations of which protocol(s) are described in the server track(s);

3) There is a specific design of the server hint tracks for each protocol which may be transmitted; all these designs use the same basic structure. For example, there may be designs for RTP (for the Internet) and MPEG-2 transport (for broadcast), or for new standard or vendor-specific protocols.

In one embodiment of the present invention, the resulting streams, sent by the servers under the direction of the hint tracks, are normal streams, and do not necessarily include a trace of QuickTime information. This embodiment of the invention does not require that QuickTime, or its structures or declaration style, necessarily be either in the data on the transmission medium (e.g. network cable) or in the decoding station. For example, a file using H.261 video and DVI audio, streamed under RTP, may result, in one embodiment of the present invention, in a packet stream which is fully compliant with the IETF specifications for packing those codings into RTP.

In one embodiment of the invention, hint tracks are built and flagged so that when the presentation is viewed locally, the hint tracks are essentially ignored by a receiving system.

In one embodiment, a time related sequence of media data, which may, for example, include video, audio, etc., may be packetized by a digital processing system, and then presented on the same digital processing system. Furthermore, packetization may be ephemeral, such that the time related sequence being presented, stored, read, etc., is also packetized "on the fly." In one embodiment, hints may refer to media data that has not been copied, formatted, etc.; for example, the media data to which hints refer may be stored in original format on a read-only memory, etc.

In one embodiment, the same hinting routine that provides packetization also presents the media as packetization is performed. In alternative embodiments of the invention, a packetized file of time related media data may be generated according to hint tracks and stored, for example, for later transmission.

Figure 4 illustrates utilization of hint tracks for transporting media data, according to one embodiment of the invention. In Figure 4, a hint track 401 is shown for the media track 403. Each hint track sample, such as hint track sample 405—which describes how to form an RTP packet—may contain a header, and may reference some data from an associated media track—in this case, a video track 403. In the embodiment shown in Figure 4, the media data (the video frames) and the RTP hints have been interleaved so that the associated media file may be read relatively easily. In this example, each frame is shown as fitting into a single RTP packet. Of course, it is possible to split frames into several packets when needed. Conversely, multiple frames can, if desired, be placed in a single packet, which is commonly performed with audio data.

As discussed above, the logical structure described above need not imply physical structure. The meta data may be cached in memory, and the hint track samples physically interleaved with the media samples to which they refer (as is shown in Figure 4).

Alternatively, it is possible to write a new set of meta data and media data, containing the hint tracks, which references and augments the meta data and media data in an existing presentation. Figure 5 illustrates utilization of hint tracks to reference media data in a separate file, according to one embodiment of the invention.

In Figure 5, two movie files 502 and 504 are shown, each with their own meta-data. The first, the movie file 502, includes a video track. The second, the movie file 504, contains both a video track and a hint track, but the meta-data declares that the media data for the video track is in the first movie 502. Thus the hints associated with the movie file 504 also point to the media data in the first movie 502.

In one embodiment of the present invention, a media file may contain packetization hint tracks for multiple protocols. As such, each track may contain declarations of the protocol (and protocol parameters, if appropriate) for which the hint track is appropriate. These tracks may all, of course, reference media data from the basic media tracks in the file. The desire for protocol independence and extensibility may be met in the described manner.

In one embodiment of the present invention, hint tracks need not use all the data in the media tracks. The hint tracks may use a subset of the data (e.g. by omitting some video frames) to reach a bandwidth threshold, or for other reasons. Since multiple hint tracks may be provided for the same protocol, differing subsets of the same basic media information at different rates may be provided. As such, the present invention may provide improved scalability over prior methods and apparatuses.

It should be emphasized that though the hint tracks themselves, and the QuickTime meta-data, should, in one embodiment, be in QuickTime files, the base media can be left in any file type which QuickTime can import and reference in place. In one embodiment of the present invention, the meta-data in the movie file may include a data reference which declares that the media data is in another file. The sample table offsets and pointers may thus refer to data in this 'foreign' file. Thus,

according to one embodiment of the present invention, existing legacy formats such as "au" audio files, "AVI" audio/video files, and MIDI files, may be streamed without requiring the copying or reformatting of the base media data. Since the base media data is not written to, but merely augmented by QuickTime declarations and hint information in separate files, the base media data may also be provided on read-only machine readable media such as CDROM.

In one embodiment of the present invention, the hint tracks embody the results of off-line computation and are typically optimized to provide the server with information to support packetization, and if needed, multiplexing.

Example hints, for example, for RTP (the IETF standard real-time protocol) and MPEG-2 transport are shown in Appendixes A-C.

In one embodiment of the present invention, a single file may support hint tracks for multiple protocols, or multiple different parameterizations of the same protocols, without undue space overhead. New protocols, and their associated hint tracks, may be designed without disrupting systems relying on existing protocols. Thus the invention, at least in one embodiment, is protocol-neutral.

In the QuickTime file format, a track may be added to the movie by updating or copying and augmenting the meta-data. If the media data is in files separate from the meta-data, or optimized interleave is not required, this can be a relatively simple and efficient operation.

In one embodiment of the present invention, tracks may be extracted by building a new set of movie meta-data which contains only one track, and which can, if desired, reference the media data in the original.

For example, in one embodiment of the present invention, a new audio track may be added which is marked as being an alternative to a set of other audio tracks. If it is also marked with the language code (e.g. French, or Tagalog), then the appropriate track may be selected at presentation time.

SMPTE time-code tracks are an example of elementary streams which may be present, added, or removed, as need arises, according to one embodiment of the invention.

According to one aspect of the invention, hint tracks may permit the development of new formats for new protocols without causing compatibility issues for existing servers or local playback. In addition, new media tracks may be added over the life of the file format while maintaining backwards compatibility.

In one embodiment of the present invention, the areas of extensibility include:

a) New track types which can be defined for media types not covered by the current QuickTime file format (e.g. laboratory instrument readings).

b) New coding types for existing tracks which may be defined (e.g. video or audio codecs). There is explicit provision for their codec-specific initialization information.

c) New hint track types which may be defined for new protocols, and a file which may contain hint information for more than one protocol without incurring a space overhead for the media data itself.

Existing content on read-only media may be used with the present invention (e.g., prepackaged movies on CD ROM, DVD, etc.).

Furthermore, according to one aspect of the invention, various "foreign" file formats may be used. In one embodiment of the present invention, for example, if the existing content is either in QuickTime format, or can be imported, it may be edited and streamed without requiring copying or re-formatting.

In one embodiment of the present invention, if a codec supports striping of the media data to achieve scalability of bandwidths, then these striped bandwidths may be represented using multiple stream tracks. Each track may represent a different bandwidth. Tracks may be grouped together in selected subsets of the basic media.

In one embodiment of the present invention, if a protocol supports bandwidth scalability, then the hint track itself may contain information for each protocol data unit (sample in the hint track). Information may include the bandwidth threshold above which the protocol data unit should be delivered to the network. Thus, hint tracks may indicate an available bandwidth as being high, low, etc., and/or other information relating to bandwidth for data transmission.

In one embodiment of the present invention, if the protocol is a multiplexing protocol (e.g. MPEG-2 transport) then different hint tracks may be built which use a different subset of the elementary stream tracks to achieve different data-rates. Hence, some tracks may be omitted entirely for low bit-rate transmission.

In one embodiment of the present invention, if it is desired to record the base data using different codecs, then those tracks may be formed into a group of alternatives, and only one selected for presentation. The selection of which track to use for presentation is typically protocol-dependent and may be achieved by using the hint track approaches described herein.

In one embodiment of the present invention, encryption may also be pre-applied to a media file. In this case, the encrypted data may be stored in either (a) a new elementary stream (a new track) which is linked to the original media data (or the original media data may be removed if it is no longer needed) or (b) the hint track

itself. In case (b), it is possible that the hint track does not extract any data from the elementary un-encrypted stream on the fly. Thus, all of the media data may be in the hint track as well as the streaming packet protocol data unit information, because the media data may be transformed by encryption.

As an example of embedded object content information, the IETF session description information for a whole movie, and for individual tracks, may be stored in the meta-data for the RTP hint tracks, as user atoms.

In one embodiment of the present invention, a file format typically contains both media data in a playable format, and streaming information. In one embodiment, it is possible to stream directly from this format with relatively low overhead, while preserving the media independence, protocol independence, and ability to present the media locally.

According to one aspect of the invention, hint tracks may abstract detailed knowledge of codecs, timing and packetization, into an off-line preparation process. Thus, following the hint tracks to generate the data stream may be relatively simple and require no specialized knowledge of the media being streamed. Thus, decoupling of a server, for example, from the details of the data content may be provided, according to one aspect of the invention.

In one embodiment of the present invention, a set of hint tracks may be used to construct a file which is directly optimized for streaming—for example, by laying out network PDUs on disk at logical disk boundaries, in the time sequence in which they should sent. Such a file may no longer be a general presentation, but may be

streamed. In one embodiment, packetized files created with hint tracks may be stored and, for example, later optimized for streaming.

In one embodiment of the present invention, by encapsulating foreign file formats, media data may be retained in other formats while still be published in QuickTime. For example, an existing format may be directly encapsulated into a new media data file by applying the proper wrapper, or may be left intact and referred to in segments or as a whole by the hint track, allowing the legacy formats to be streamed without copying. A single movie may contain pieces selected from multiple legacy formats. This invention does *not* constrain the base media format.

In general, a common format which spans capture, authoring and editing, download and streaming, will generally provide flexibility. Material may be reworked after use, or used in multiple ways, without being copied or re-formatted. In one embodiment of the present invention, it is possible to re-work and re-use material which has been hinted, by stripping the hint tracks, using standard editors, and then re-hinting after editing is completed.

If it is desired that a media file be downloaded for local viewing, an optimized interleaved file may be built for that purpose, with the streaming meta-data in a separate declaration file referencing the same base media data. The download may not, therefore, include the streaming information, and yet the media data may be present only once at a streaming server.

By separating logical structure from physical structure, the physical structure of the file may be optimized differently depending on the application (e.g. editing, local viewing, streaming).

By permitting the existence of multiple hint tracks for each media track, in one embodiment of the present invention, the file may be published by streaming over multiple protocols, without requiring multiple copies of the media.

Figure 6 is a diagram of a network of computer systems in which media data may be processed, according to one embodiment of the present invention. As shown in Figure 6, a number of client computer systems, one or more of which may represent one implementation of the receiving system described above with reference to Figure 3, are coupled together through an Internet 622. It will be appreciated that the term "Internet" refers to a network of networks. Such networks may use a variety of protocols for exchange of information, such as TCP/IP, ATM, SNA, SDI, etc. The physical connections of the Internet and the protocols and communication procedures of the Internet are well known to those in the art. Access to the Internet 103 is typically provided by Internet service providers (ISPs), such as the ISP 624 and the ISP 626. Users on client systems, such as the client computer systems 602, 604, 618, and 620, generally obtain access to the Internet through Internet service providers, such as ISPs 624 and 626. Access to the Internet may facilitate transfer of information (e.g., email, text files, media files, etc.) between two or more digital processing systems, such as the client computer systems 602, 604, 618, and 620 and/or a Web server system 628. For example, one or more of the client computer systems 602, 604, 618, and 620 and/or the Web server 628 may provide media data (e.g., video and audio, or video, or audio) to another one or more of the client computer systems 602, 604, 618, and 620 and/or the Web server 628. Such may be provided in response to a request. As described herein, such media data may be

transferred in the system 600 according hints. Such hints, in one embodiment of the invention, may be created according to a specific format of the media data and/or a specific data communication (e.g., network) protocol(s).

The Web server 628 is typically comprised of at least one computer system to operate with one or more data communication protocols, such as the protocols of the World Wide Web, and as such, is typically coupled to the Internet 622. Optionally, the Web server 628 may be part of an ISP which may provide access to the Internet and/or other network for client computer systems. The client computer systems 602, 604, 618, and 620 may each, with appropriate web browsing software, access data, such as HTML documents (e.g., Web pages), which may be provided by the Web server 628. Such data may provide media, such as QuickTime movies, which may be presented by the client computer systems 602, 604, 618, and 620.

The ISP 624 provides Internet connectivity to the client computer system 602 via a modem interface 606, which may be considered as part of the client computer system 602. The client computer system may be a conventional computer system, such as a Macintosh computer, a "network" computer, a handheld/portable computer, a Web TV system, or other types of digital processing systems (e.g., a cellular telephone having digital processing capabilities). Similarly, the ISP 626 provides Internet connectivity for the client computer systems 604, 618 and 620, although as depicted in Figure 6, such connectivity may vary between various client computer systems, such as the client computer systems 602, 604, 618, and 620. For example, as shown in Figure 6, the client computer system 604 is coupled to the ISP 626 through a modem interface 608, while the client computer systems 618 and 620 are

part of a Local Area Network (LAN). The interfaces 606 and 608, shown as modems 606 and 608, respectively, in Figure 6, may be an analog modem, an ISDN modem, a cable modem, a satellite transmission interface (e.g., "Direct PC"), a wireless interface, or other interface for coupling a digital processing system, such as a client computer system, to another digital processing system. The client computer systems 618 and 620 are coupled to a LAN bus 612 through network interfaces 614 and 616, respectively. The network interfaces 614 and 616 may be an Ethernet-type, Asynchronous Transfer Mode (ATM), or other type of network interface. The LAN bus is also coupled to a gateway digital processing system 610, which may provide firewall and other Internet-related services for a LAN. The gateway digital processing system 610, in turn, is coupled to the ISP 626 to provide Internet connectivity to the client computer systems 618 and 620. The gateway digital processing system 610 may, for example, include a conventional server computer system. Similarly, the Web server 628 may, for example, include a conventional server computer system.

The system 600 may allow one or more of the client computer systems 602, 604, 618, and 620 and/or the Web server 628 to provide media data (e.g., video and audio, or video, or audio) to another one or more of the client computer systems 602, 604, 618, and 620 and/or the Web server 628. Such data may be provided, for example, in response to a request by a receiving system, which may be, for example, one or more of the client computer systems 602, 604, 618, and 620. As described herein, such media data may be transferred in the system 600 according hints or hint tracks. Such hints, in one embodiment of the invention, may be created according to a specific format of the media data and/or a specific data communication (e.g., network)

protocol(s) to allow, according to one aspect of the invention, packetization of media data.

Figure 7 is a block diagram of a digital processing system which may be used in accordance with one embodiment of the present invention. For example, the digital processing system 650 shown in Figure 7 may be used as a client computer system, a Web server system, a conventional server system, etc. Furthermore, the digital processing system 650 may be used to perform one or more functions of an Internet service provider, such as the ISP 624 or 626. The digital processing system 650 may be interfaced to external systems through a modem or network interface 668. It will be appreciated that the modem or network interface 668 may be considered as part of the digital processing system 650. The modem or network interface 668 may be an analog modem, an ISDN modem, a cable modem, a token ring interface, a satellite transmission interface, a wireless interface, or other interface(s) for providing a data communication link between two or more digital processing systems.

The digital processing system 650 includes a processor 652, which may represent one or more processors and may include one or more conventional types of such processors, such as a Motorola PowerPC processor, an Intel Pentium (or x86) processor, etc. A memory 155 is coupled to the processor 652 by a bus 656. The memory 155 may be a dynamic random access memory (DRAM) and/or may include static RAM (SRAM). The processor may also be coupled to other types of storage areas/memories (e.g., cache, Flash memory, disk, etc.), which could be considered as part of the memory 155 or separate from the memory 155.

The bus 656 further couples the processor 652 to a display controller 658, a mass memory 662, the modem or network interface 668, and an input/output (I/O) controller 664. The mass memory 662 may represent a magnetic, optical, magneto-optical, tape, and/or other type of machine-readable medium/device for storing information. For example, the mass memory 662 may represent a hard disk, a read-only or writeable optical CD, etc. The display controller 658 controls in a conventional manner a display 660, which may represent a cathode ray tube (CRT) display, a liquid crystal display (LCD), a plasma display, or other type of display device. The I/O controller 664 controls I/O device(s) 666, which may include one or more keyboards, mouse/trackball or other pointing devices, magnetic and/or optical disk drives, printers, scanners, digital cameras, microphones, etc.

It will be appreciated that the digital processing system 650 represents only one example of a system, which may have many different configurations and architectures, and which may be employed with the present invention. For example, Macintosh and Intel systems often have multiple busses, such as a peripheral bus, a dedicated cache bus, etc. On the other hand, a network computer, which may be used as a digital processing device of the present invention, may not include, for example, a hard disk or other mass storage device, but may receive routines and/or data from a network connection, such as the modem or interface 668, to be processed by the processor 652. Similarly, a Web TV system, which is known in the art, may be considered to be a digital processing system of the present invention, but such a system may not include one or more I/O devices, such as those described above with reference to I/O device(s) 666. Additionally, a portable communication and data

processing system, which may employ a cellular telephone and/or paging capabilities, may be considered a digital processing system which may be used with the present invention.

In the system 650 shown in Figure 7, the mass memory 662 (and/or the memory 654) may store media (e.g., video, audio, movies, etc.) which may be processed according the present invention (e.g., by way of hints). Alternatively, media data may be received by the digital processing system 650, for example, via the modem or network interface 668, and stored and/or presented by the display 660 and/or I/O device(s) 666. In one embodiment, packetized media data may be transmitted across a data communication network, such as a LAN and/or the Internet, in accordance with hint tracks. On the other hand. the processor 652 may execute one or more routines to use a file with one or more hint tracks, or alternatively, to create one or more hint tracks, to process media (e.g., a pre-packaged movie, audio file, video file, etc.) for presentation or packetization according to the hint tracks. Such routines may be stored in the mass memory 662, the memory 664, and/or another machine-readable medium accessible by the digital processing system 650. In one embodiment, the digital processing system 650 may process media data having hint tracks embedded therein. Similarly, such embedded media data may be stored in the mass memory 662, the memory 664, and/or another machine-readable medium accessible by the digital processing system 650.

Figure 8 is a block diagram of a system that utilizes hints to transfer media data, according to one embodiment of the invention. The system 680 shown in Figure 8 includes a receiving system, which is depicted as a client data processing system

682 coupled to a server 694, via a data communication link 686. The server 694 and/or client data processing system may, for example, represent one or a combination of the devices/systems described with reference to Figures 6 and 7.

The server 694 includes a hint generation and processing unit 688, a media processing unit 690, and a data communication unit 692, each of which may include hard-wired circuitry or machine-executable instructions or a combination thereof. Furthermore, at least a portion of such hard-wired circuitry and/or machine-executable instructions may be shared between a combination of the hint generation and processing unit 688, the media processing unit 690, and the data communication unit 692. In one embodiment, at least one storage area/memory (e.g., a machine-readable medium) having appropriate routines and/or data stored therein coupled to at least one processor is utilized, at least in part, to implement one or a combination of the hint generation and processing unit 688, the media processing unit 690, and the data communication unit 692.

In one embodiment, the hint generation and processing unit 688 creates and stores hints for packetization of media data processed by the media processing unit 690. As described above, the hints may be generated and stored as a separate file, relative to media files or may be embedded with media data. If more than one media format is to be processed, an appropriate format may be taken into consideration by the hint generation and processing unit 688 to generate the hints. Information about the media format may be provided by the media processing unit 690, which may also provide the media data (e.g., media files of video, audio, or video and audio, etc.). Similarly, the data communication unit 692 may provide one or more data

communication (e.g., network) protocols for exchange of such media data, packetized according to the hints, via the data communication link 686. As such, the hint generation and processing unit may determine, based on media format information provided by the media processing unit 690 and data communication protocol information provided by the data communication unit 692, appropriate hints and packetization of media and/or the hints for transfer to a receiving digital processing system, such as the client data processing system 682. In one embodiment, the streaming of the media and hints is done in accordance with the QuickTime format.

In response to media data and hint packets received via the data communication link 686, the client data processing system 682 may present a media object represented by the media data. Such presentation may be performed ephemerally, as described above. In one embodiment of the invention, the media data may optionally be stored by the client data processing system 682 and reassembled, for example, at a later time, for presentation and/or transmission by the client data processing system 682.

Figure 9 is a block diagram of a system that utilizes hints to transfer media data, according to one embodiment of the invention. In particular, Figure 9 depicts an embodiment of the invention wherein a separate digital processing system, referred to as a generator, may generate hints (or hint tracks) to provide to another system, such a server, that uses the hints to packetize media data for transfer to another system, such as a client computer system. A system 696 is shown in Figure 9, which includes a server 700 which may exchange data, via the data communication link 686, with the client data processing system 682. However, in the embodiment shown in Figure 9, the server 700 does not generate the hints. Rather, a generator 710, coupled to the

server 700 by a data communication link 708, includes a hint generation unit 712 to generate hints that are used to packetize media data.

In one embodiment, the operation of the system 696 is as follows: the server 700 makes a request to the generator 710 to generate hints for one or more media files containing media data. For example, the media files may be stored in the server 700 on a machine-readable medium. The request may include information to indicate the format of the media file and/or a data communication protocol for transmission of the media data and/or other data. The data communication protocol may be related to the data communication link 686, which may, in one embodiment of the invention, be associated with a network connection having particular physical and logical characteristics to facilitate exchange of media and/or other data between the server 700 and the client data processing system 682. In response to the request, the hint generation unit 712 generates appropriate hints, which may be associated with a time-related hint track, and provides the hints to the server 700. In response to the hints received from the generator 710, via the data communication link 708, the server 700, and in particular, a hint processing unit 702 uses the hints to packetize the media data for transmission to the client data processing system 682.

In response to media data and hint packets received via the data communication link 686, the client data processing system 682 may present a media object represented by the media data. Such presentation may be performed ephemerally, as described above. In one embodiment of the invention, the media data may optionally be stored by the client data processing system 682 and reassembled, for example, at a later time, for presentation and/or transmission by the client data processing system 682.

Figure 10 is a flow diagram illustrating a method for generating hints for providing media data transmission, according to one embodiment of the invention. In step 720, a media format is determined for media data to be transmitted, if more than one format will be used. If only one format is used, 720 may not be performed. In step 722, an appropriate data communication protocol(s) is determined, again, assuming that more than one (protocol) may be used. In step 724, based on the media format and the data communication protocol(s) (one or both of which may have been selected/configured), hints (e.g., hint tracks) related to media data transmission are created and stored.

In step 726, which is optional, the hints may be transmitted to another digital processing system. In one embodiment of the invention, for example, the method of Figure 10, at least in part, may be performed exclusively by one digital processing system (e.g., a server). In an alternative embodiment, the method of Figure 10, at least in part, may be performed by two or more digital processing systems. For example, attributes of media data may be provided by a server or other system to another digital processing system, such as a generator. In response, the generator may determine, based on the attributes, an appropriate media format, data communication protocol(s), and hints for packetization of media data, which may be stored at the server. Alternatively, the server may provide the appropriate media format and protocol(s) to the generator, which could then generate hints. The generator may transmit the hints to the server or other digital processing system, which could packetize media data according to the hints.

Figure 11 is a flow diagram illustrating a method of processing media data received by a receiving system in accordance with hints, according to one embodiment of the invention. In step 730, media data transmitted according to a receiving system in accordance with hints or hint tracks is received by the receiving system. In one embodiment, the receiving system may receive packetized media data, as well as packetized hint tracks. The hint tracks, in one embodiment of the invention, may be associated with at least portions of the media data. Such data may be received by the receiving system in response to a request that may be made by the receiving system. For example, in one embodiment, the receiving system may be a client computer system and the request may be made to a server or other digital processing system for the media data. In response, the server may generate (or have generated for it by a separate digital processing system) hints for packetizing the media data, and transmit the packetized media data, which may include hints, to the receiving system.

In step 732, a media object represented by the media data received by the receiving system is presented by the receiving system. For example, the media data may include video, audio, or combination thereof that is "presented" by the receiving system, for example, on a display and speaker(s). As mentioned above, the media data may be associated with a QuickTime movie.

Optionally, in step 734, the media data, which may include hints, may be stored by the receiving system as a media file(s). Thus, in alternative embodiments of the invention, step 732 may not be performed as the media data is received, or may be performed before, after, or in parallel with step 734.

In step 734, the stored media file may optionally be reassembled and/or presented. As such, step 732 may be performed subsequent to step 734.

Figure 12 is an example of a machine readable storage medium that may be accessed by a digital processing system, such as a generator, according to one embodiment of the invention. It will be appreciated that the actual memory that stores the elements shown in and described below with reference to Figure 12 may be one or several elements, such as one or more disks (which may, for example, be magnetic, optical, magneto-optical, etc.), the memory 654 and/or the mass memory 662 described above with reference to Figure 7. Furthermore, in one embodiment where the generator, with which the machine readable storage medium shown in Figure 12 is associated, is a network computer, one or more of the elements of the machine readable storage medium may be stored at another digital processing system and downloaded to the generator. Furthermore, the elements described with reference to the machine readable storage medium may, at some point in time, be stored in a non-volatile mass memory (e.g., a hard disk). Conversely, at other times, the elements of the machine storage medium may be dispersed between different storage areas, such as DRAM, SRAM, disk, etc.

Figure 12 shows a machine readable storage medium 740. In one embodiment, the machine readable storage medium is utilized, at least in part, by a digital processing system that generates hints or hint tracks, i.e., a generator, in accordance with one or more method(s) of the invention. The generator, as described with reference to Figure 8, may be integrated into a digital processing system that transmits media data according to the hint tracks, or may be, as described with

reference to Figure 9, a digital processing system that creates and provides the hints to another digital processing system, such as a server, which utilizes the hints to packetize and transmit media data.

As shown in Figure 12, the machine readable storage medium 740 typically includes a number of elements. For example, the machine readable storage medium 740 includes software for providing operating system functionality to the generator, as depicted by a generator operating system (OS) 742. A network transmission routine(s) 748 provides data communication functionality, such as routines, protocols, etc., to allow the generator to transmit and receive data via a data communication link.

In addition, the machine readable storage medium 740 includes routines and data for creating hints associated with media transmission. As such, the machine readable storage medium 740 may optionally include information 750, which may provide information relating to one or more data communication protocols and media formats which may be necessary for creation of hints by a hint creation routine(s) 744. For example, the information 750 may include information relating to QuickTime movies, RTP, MPEG, etc. However, such information may, at least in part, be integrated into the hint creation routine 744 and/or be provided to the generator by a remote digital processing system.

The hints created by the hint creation routine(s) 744 may be stored as created hints 746 and/or stored/transmitted elsewhere (e.g., at a remote digital processing device, which may be a server). The hints are hint tracks that are time-related for packetization and transmission of media data, which is also time-related (e.g., video, audio, video and audio, etc.).

Although the machine readable storage medium 740 is described with reference to a generator, the medium 740, at least in part, may be part of a number of types of digital processing systems, data storage media, etc. For example, the machine readable storage medium 740, at least in part, may be included as part of a server or other digital processing system. Furthermore, the machine readable storage medium 740, at least in part, may be included as part of a software utility on one or more disks or other machine readable media.

Figure 13 is an example of a machine readable storage medium that may be accessed by a digital processing system, such as a server, according to one embodiment of the invention. It will be appreciated that the actual memory that stores the elements shown in and described below with reference to Figure 13 may be one or several elements, such as one or more disks (which may, for example be magnetic, optical, magneto-optical, etc.), the memory 654 and/or the mass memory 662 described above with reference to Figure 7. Furthermore, in one embodiment where the server, with which the machine readable storage medium shown in Figure 13 is associated, is a network computer, one or more of the elements of the machine readable storage medium may be stored at another digital processing system and downloaded to the server. Furthermore, the elements described with reference to the machine readable storage medium may, at some point in time, be stored in a non-volatile mass memory (e.g., a hard disk). Conversely, at other times, the elements of the machine storage medium may be dispersed between different storage areas, such as DRAM, SRAM, disk, etc.

Figure 13 shows a machine readable storage medium 760. In one embodiment, the machine readable storage medium is utilized, at least in part, to packetize media data for transmission on a data communication link in accordance with one or more method(s) of the invention. The machine readable storage medium 760 may be associated with a server, such as the server 694 described with reference to Figure 8, to include routines to create hint tracks and transmit media data according to the hint tracks. In another embodiment, the machine readable storage medium 760 may be associated with a digital processing system, such as the server 700 described with reference to Figure 9, wherein a digital processing system, such a generator, includes routines to create hints, and the server, using the hints as processed by routines provided by the machine readable storage medium 760, may packetize and transmit media data.

The machine readable storage medium 760 includes a number of elements. For example, the machine readable storage medium 760 includes software for providing operating system functionality to the server, as depicted by a server operating system (OS) 762. A network transmission routine(s) 768 provides data communication functionality, such as routines, protocols, etc., to allow the server to transmit and receive data via a data communication link.

In addition, the machine readable storage medium 760 includes a media packetization routine 770 for packetizing media data, which may be time-related, based on hints, and which may also be packetized. Accordingly, the machine readable storage medium 760 includes a media data storage area 764 and a hint storage area 766 to store media data (which may, for example, be QuickTime movies or other media

tracks) and hints (e.g., hint tracks), respectively. The hints may include hint tracks that are time-related for packetization and transmission of media data, which is also typically time-related (e.g., video, audio, video and audio). In one embodiment, the hint tracks are packetized separately from the media data packets. In one embodiment, hints include pointer information identifying media data (e.g., a particular packet(s)) which may be in a separate media file.

Figure 14 is an example of a machine readable storage medium that may be accessed by a digital processing system, such as a receiving system or other digital processing system, according to one embodiment of the invention. It will be appreciated that the actual memory that stores the elements shown in and described below with reference to Figure 14 may be one or several elements, such as one or more disks (which may, for example be magnetic, optical, magneto-optical, etc.), the memory 654 and/or the mass memory 662 described above with reference to Figure 7. Furthermore, in one embodiment where the receiving system, with which the machine readable storage medium shown in Figure 14 is associated, is a network computer, one or more of the elements of the machine readable storage medium may be stored at another digital processing system and downloaded to the receiving system. Furthermore, the elements described with reference to the machine readable storage medium may, at some point in time, be stored in a non-volatile mass memory (e.g., a hard disk). Conversely, at other times, the elements of the machine storage medium may be dispersed between different storage areas, such as DRAM, SRAM, disk, etc.

Figure 14 shows a machine readable storage medium 780. In one embodiment, the machine readable storage medium is utilized, at least in part, to

process media data packetized in accordance with one or more method(s) of the invention. The machine readable storage medium 780 may be associated with a receiving system, such as the client data processing system 682 described with reference to Figures 8 and 9, to include routines to present media data transmitted/received according to hints. Alternatively, the machine readable storage medium 780 may include media data having hints (e.g., hint tracks) embedded therein. Such embedded media data may be pre-packaged or generated by a routine stored on a machine readable storage medium, such as the machine readable storage medium 780.

The machine readable storage medium 780 may include a number of elements. For example, the machine readable storage medium 780 includes software for providing operating system functionality to the receiving system, as depicted by a server operating system (OS) 772. A network transmission routine(s) 782 provides data communication functionality, such as routines, protocols, etc., to allow the server to transmit and receive data via a data communication link.

In addition, the machine readable storage medium 780 includes a media presentation routine 778 for presenting media data packetized according to hints. Thus, the machine readable storage medium 780, and in particular, the media presentation routine 778, may include routines for decompression of audio and/or video data, displaying of video, and/or playing back audio, etc. Furthermore, the media presentation routine 778 typically provides handling of hints that are associated with the media data. In one embodiment, the hints are simply ignored as media is presented.

Optionally, the machine readable storage medium 780 may store media data that has been packetized according to hints as media data 774, and include a media data reassembly routine 776 to reassemble to the stored media data (e.g., to be presented, transmitted, etc.).

Figure 15 is a diagram of a data storage and/or communication medium having stored/transported thereon media and hint information, according to one embodiment of the invention. A data storage and/or communication medium (medium) 800 is shown, which represents various types of transport and/or storage medium in which a media data packet 804 and a hint packet 806 packetized according to the present invention could be stored or transported. For example, the medium 800 may represent the mass memory 662 and/or the memory 654, described above with reference to Figure 7. The medium 800 may also represent a communication medium, such as the LAN bus 612 shown in Figure 6 or the data communication link 686 for transporting data/signals representing media and/or other information.

The hint packet 806 and the media packet 804 may be integrated into one packet or be stored and/or transported separately, as depicted in Figure 15. Furthermore, the hint packet 806 and the media packet 804 may embody several types of formats, such as ones described herein or one associated with other media formats, network protocols, and/or digital processing device architecture.

Provided below are some example formats of hints. It will be appreciated that the present invention, however, may be utilized with various types of network protocols, digital processing system architectures, media formats, etc., to provide transmission of time-based data.

ALTERNATIVE EMBODIMENTS

While the invention has been described in terms of several embodiments and illustrative figures, those skilled in the art will recognize that the invention is not limited to the embodiments or figures described. In particular, the invention can be practiced in several alternative embodiments that provide packetization of time related media data.

Therefore, it should be understood that the method and apparatus of the invention can be practiced with modification and alteration within the spirit and scope of the appended claims. The description is thus to be regarded as illustrative instead of limiting on the invention.

Appendix A - Packetization Hint Sample Description

In one embodiment of the present invention, each hint track has a table of sample descriptions. Hint tracks typically have one sample description. The format for each sample description entry for a hint track, according to one embodiment of the present invention, is described below in Table 1.

Table 1: Hint Track Sample Description Format

Hint Track Sample Description	Bytes
Sample description size	4
Data format	4
Reserved	6
Data reference index	2
Max packet size	4
Additional data table	variable

The packetization hint header atom contains the following data elements:

Field descriptions:

Sample description size	A 32-bit integer that specifies the number of bytes in the sample description.
Data format	A 32-bit integer indicating the format of the hints stored in the sample data. Different formats may be defined for different hint types. The table below lists defined formats.
Reserved	Six bytes that are set to 0.
Data reference	A 16-bit integer that contains the index of the data index associated with the samples that use this sample description. Data references are stored in data reference atoms.
Max packet size	A 32-bit integer indicating the maximum size of packets computed in this track.
Additional Data Table	A table containing additional information needed on a per track basis. The values are tagged entries. There are no required entries. If an entry is not present in the table, a reasonable default may be used.

The structure for the additional data table entries is shown in Table 2.

Table 2: Additional Data Table Format

Additional Data Table	Bytes
Entry length	4
Data type	4
Data	Entry length - 8

The additional data table entries contain the following data elements:

Field descriptions:

Entry length	A 32-bit integer indicating the length of the entire entry (includes 8 bytes for the length and type fields) in bytes.
Data type	A 32-bit integer indicating the meaning of the data in the entry.
Data	The data for this entry. The length of the data is indicated by the Data length field of the table.

The following data tags may defined for several various types of data format types. Other tags may be created as required.

Length	Type	Data Description
9	'rely'	A 1 byte integer indicating whether or not this track should be sent over a reliable transport. Values of 0 and 1 are defined. If this tag is not present, it is assumed to have the value zero, indicating that it can be sent over unreliable transports, such as UDP.

The following data format types are defined. New types may be defined as needed.

Data Format	Description
'rtp'	The packetization hints for sending media over RTP for the specific media type and encoding as described by various IETF drafts of the Audio-Video Transport (AVT) working group.

The following data tag is utilized in one embodiment for 'rtp' data.

Length	Type	Data Description
12	'tims'	A 32-bit number indicating the RTP timescale. This tag is present in one embodiment for RTP data.

The following data tags are optional for 'rtp' data.

Length	Type	Data Description
12	'tsro'	A 32-bit number indicating the random offset to add to the stored time stamp when sending the RTP packets. If this field is not present, a truly random number should be used, as per the RTP specification. The value of this field could be zero, indicating that no random offset is to be added.
10	'snro'	A 16-bit number indicating the random offset to add to the sequence

number when sending the RTP packets. If this field is not present, a truly random number should be used, as per the RTP specification. The value of this field could be zero, indicating that no random offset is to be added.

Appendix B — Example hint track for RTP

This section presents one example of a hint track format for streaming RTP from a QuickTime movie.

In standard RTP, each media stream is typically sent as a separate RTP stream. Multiplexing is generally achieved by using IP's port-level multiplexing, not by interleaving the data from multiple streams into a single RTP session. Therefore each media track in the movie should have an associated RTP hint track. In one embodiment of the present invention, each hint track contains a track reference back to the media track which it is streaming.

In this example, the packet size is determined at the time the hint track is created. Therefore, in the sample description for the hint track (a data structure which can contain fields specific to the 'coding' – which in this case is a protocol), the chosen packet size is indicated. In one example of the present invention, several RTP hint tracks are provided for each media track to provide different packet size choices. Other protocols may be parameterized as well. Similarly, the appropriate time-scale for the RTP clock is provided in the sample description below.

The hint track is related to its base media track by a single track reference declaration. (RTP does not permit multiplexing of media within a single RTP stream). The sample description for RTP declares the maximum packet size which this hint track will generate. Session description (SAP/SDP) information is stored in user-data atoms in the track.

Each sample in the RTP hint track contains the instructions to send out a set of packets which must be emitted at a given time. The time in the hint track is emission time, not necessarily the media time of the associated media.

In the following description the internal structure of samples, which are media data, not meta data, in the terminology of this example is described, need not be structured as objects.

In this example, each sample contains two areas: the instructions to compose the packets, and any extra data needed when sending those packets (e.g. an encrypted version of the media data).

```
struct RTPsample {
      int(16)      packetcount;
      RTPpacket    packets[packetcount];
      byte[]       extradata;
}
```

Each RTP hint packet contains the information to send a single packet. In one embodiment, to separate media time from emission time, an RTP time stamp is specifically included, along with data needed to form the RTP header. In alternative embodiments, however, this is not the case. Other header information is typically supplied. A table of construction entries is constructed as follows:

```
struct RTPpacket {
      int(32)     RTPtime;
      int(16)     partialRTPheader;
      int(16)     RTPsequenceseed;
      int(16)     entrycount;
      dataentry   constructors[entrycount];
}
```

There are various forms of the constructor. Each constructor is 16 bytes, which may make iteration relatively simple. The first byte is a union discriminator:

```
struct dataentry {
      int(8) entrytype;
      switch entrytype {
            case immediate:
                  int(8)            bytecount;
                  int(8)            bytestocopy[bytecount];
            case mediasample:
                  int(8)      reserved[5];
                  int(16)     length;
                  int(32)     mediasamplenumber;
                  int(32)     mediasampleoffset;
            case hintsample:
                  int(8)      reserved[5];
                  int(16)     length;
                  int(32)     hintsamplenumber;
                  int(32)     hintsampleoffset;
      }
}
```

The immediate mode permits the insertion of payload-specific headers (e.g. the RTP H.261 header). For hint tracks where the media is sent 'in the clear', the mediasample entry may specify the bytes to copy from the media track, by giving the sample number, data offset, and length to copy. For relatively complex cases (e.g. encryption or forward error correction), the transformed data may be placed into the hint samples, and then hintsample mode may be used, which would be provided from the extradata field in the RTPsample itself.

In one example of the present invention, there is no requirement that successive packets transmit successive bytes from the media stream. For example, to

conform with RTP-standard packing of H.261, in one example of the present invention, a byte may be sent at the end of one packet and also at the beginning of the next (when a macroblock boundary falls within a byte).

Appendix C - Packetization Hint Sample Data for Data Format 'rtp'

This appendix provides a description of the sample data for the 'rtp' format, according to one embodiment of the invention. The 'rtp' format assumes that a server is sending data using Real Time Transport Protocol (RTP). This format assumes that the server knows about RTP headers, but does not require that the server know anything about specific media header, including media headers defined in various IETF drafts.

In one embodiment of the present invention, each sample in the hint track will generate one or more RTP packets. Each entry in the sample data table in a hint track sample corresponds to a single RTP packet. Samples in the hint track may or may not correspond exactly to samples in the media track. In one embodiment of the present invention, data in the hint track sample is byte aligned, but not 32-bit aligned.

Field descriptions:

Entry count	A 16-bit unsigned integer indicating the number of packet entries in the table. Each entry in the table corresponds to a packet. Multiple entries in a single sample indicate that the media sample had to be split

into multiple packets. A sample with an entry count of zero is reserved and if encountered, should be skipped.

Packet entry table — A variable length table containing packet entries. Packet entries are defined below.

Additional data — A variable length field containing data pointed to by the entries in the data table shown below by Table 3:

Table 3 - Additional Data

Packet Entry	Bytes
Relative packet transmission time	4
Flags	4
RTP header info	2
RTP sequence number	2
Entry count	2
Data table	variable

In one embodiment, the packet entry contains the following data elements:

Field descriptions:

relative packet transmission time — A 32-bit signed integer value, indicating the time, in hint track's timescale, to send this packet relative to the hint sample's actual time. Negative values mean that the packet will be sent earlier than real

time, which is useful for smoothing the data rate. Positive values are useful for repeating packets at later times. Within each hint sample track, each packet time stamp is nondecreasing.

flags — A 32-bit field indicating certain attributes for this packet.

The RTP header information field contains the following element:

Field	Bit #	Description
R	31	A 1-bit number indicating that this is a repeat packet - the data has been defined in a previous packet. A server may choose to skip repeat packets to help it catch up when it is behind in its transmission of packets. All repeated packets for a given packet care in the same hint sample.

All undefined bits (0-30) are reserved and are set to zero.

RTP header info — A 16-bit integer specifying various values to be set in the RTP header.

The RTP header information field contains the following elements:

Field	Bit#	Description

P	2	A 1-bit number corresponding to the padding (P) bit in the RTP header. This bit may not be set, since a server that needed different packet padding may generally need to un-pad and re-pad the packet itself.
X	3	A 1-bit number corresponding to the extension (X) bit in the RTP header. This bit may not be set, since a server that needs to send its own RTP extension may either not be able to, or may be forced to replace any extensions from the hint track.
M	8	A 1-bit number corresponding to the marker (M) bit in the RTP header.
payload type	9-15	A 7-bit number corresponding to the payload type (PT) field of the RTP header.

All undefined bits (0-1 and 4-7) are reserved and are set to zero. The location of the defined bits are in the same bit location as in the RTP header.

RTP sequence number	A 16-bit integer specifying the RTP sequence number for the packet. The RTP server adds a random offset to this sequence number before transmitting the packet. This field allows re-transmission of packets, e.g., the same packet can

be assembled with the same sequence number and a different (later) packet transmission time. For example, a text sample with a duration of 5 minutes can be retransmitted every 10 seconds so that clients that miss the original sample transmission (perhaps they started playing a movie in the middle) will be "refreshed" after a maximum of 10 seconds.

Entry count — A 16-bit unsigned integer specifying the number of entries in the data table.

Data table — A table that defines the data to be put in the payload portion of the RTP packet. This table defines various places the data can be retrieved, and is shown by Table 4.

Table 4 - Data Table

Data table entry	Bytes
Data source	1
Data	15

The data source field of the entry table indicates how the other 15 bytes of the entry are to be interpreted. Values of 0 through 4 are defined. The various data table formats are defined below. Although there are various schemes, the entries in the various schemes are typically 16 bytes long.

No-Op Data Mode

The data table entry has the following format for no-op mode:

Field description:

Data source = 0	A value of zero indicates that this data table entry is to be ignored.

Immediate Data Mode

The data table entry has the following format for immediate mode:

Field description:

Data source = 1	A value of one indicates that the data is to be immediately taken from the bytes of data that follow.
Immediate length	An 8-bit integer indicating the number of bytes to take from the data that follows. Legal values range from 0 to 14.
Immediate data	14 bytes of data to place into the payload portion of the packet. Only the first number of bytes indicated by the immediate length field are used.

Sample Mode

The data table entry has the following format for sample mode:

Field description:

Data source =2	A value of two indicates that the data is to be taken from a track's sample data.
Track ref index	A value that indicates which track the sample data will come from. A value of zero means that there is exactly one media track referenced, which is to be used. Values from 1 to

	127 are indices into the hint track reference atom entries, indicating from which original media track the sample is to be read. A value of -1 means the hint track itself, i.e., the sample from the same track as the hint sample currently being parsed is used.
Bytes per compression block	A 16-bit unsigned integer specifying the number of bytes that results from compressing the number of samples in the Samples per compression block field. A value of zero is equivalent to a value of 1.
Samples per compression block	A 16-bit unsigned integer specifying the uncompressed samples per compression block. A value of zero is equivalent to a value of 1.
Length	A 16-bit integer specifying the number of bytes in the sample to copy.
Sample Number	A 32-bit integer specifying sample number of the track.
Offset	A 32-bit integer specifying the offset from the start of the sample from which to start copying. If referencing samples in the hint track, this will generally point into the Additional Data area.

If the bytes per compression block and/or the samples per compression block is greater than 1, than this ratio is used to translate a sample number into an actual byte offset. This ratio mode is typically used for compressed audio tracks in QuickTime movies, such that:

CB = NS * BPCB / SPCB

wherein,

CB = compressed bytes
NS = number of samples
BPCB = bytes per compression block
SPCB = samples per compression block

For example, a GSM compression block is typically 160 samples packed into 33 bytes. Therefore, BPCB = 33 and SPCB = 160. The hint sample requests 33 bytes of data starting at the 161st media sample. Assuming that the first QuickTime chunk contains at least 320 samples, so after determining that this data will come from chunk 1, and where chunk 1 starts, the ratio is utilized to adjust the offset into the file where the requested samples will be found:

```
chunk_number = 1; /* calculated by walking the sample-to-chunk atom*/
first_sample_in_this_chunk = 1; /* also calculated from that atom*/
chunk_offset = chunk_offsets[chunk_number]; /* from the stco atom */
data_offset = (sample_number - first_sample_in_this_chunk) * BPP / SPP
read_from_file(chunk_offset + data_offset, length); /* read our data */
```

Sample Description Mode

The data table entry has the following format for sample description mode:

Field description:

Data source = 3	A value of three indicates that the data is to be taken from the media track's sample description table.
Track ref index	A value that indicates which track the sample data will come from. A value of zero means that there is exactly one hint track reference, which is to be used. Values from 1 to 127 are indices into the hint track reference atom entries, indicating from which original media track the sample is to be read. A value of -1 means the hint track itself, i.e., the sample description from the same track as the hint sample currently being parsed is utilized.
Reserved	Four bytes that are set to zero.
Length	A 16-bit integer specifying the number of bytes in the sample to copy.
Sample description index	A 32-bit integer specifying the index into the media's sample description table.
Offset	A 32-bit integer specifying the offset from the start of the sample from which to start copying.
Additional data	A variable length field containing data pointed to by hint track sample mode entries in the data table.

Appendix D — Example hint track format for MPEG-2 Transport

This section presents one example of a simple track format for streaming MPEG-2 transport from a QuickTime movie holding elementary streams.

An MPEG-2 transport stream is associated with a multiplex of one or more elementary streams. For this reason, an MPEG-2 transport hint track describes how to construct such a multiplex from one or more media tracks. There is not necessarily a one to one relationship between media tracks and MPEG-2 transport hint tracks. Each hint track may contain references to the elementary streams it represents. In one example of the present invention, a QuickTime file might contain multiple such hint tracks to describe different multiplexes.

Packet size is generally not an issue, since all MPEG-2 transport packets are 188 bytes in size. In one example of the present invention, each transport packet (in the MPEG-2 transport protocol) contains payload data from one media track. This allows for a relatively simple hint description for each transport packet. In one example of the present invention, each such hint describes which header data appears on each transport packet, and then points to the payload in the appropriate media track for the transport packet. For packets which do not correspond with a media track, such as PSI packets, the hint may describe 188 bytes of header data, and any media track reference may be considered irrelevant. For packets which do correspond with a media track, the header data may account for information such as transport headers, possible adaptation headers, and PES headers for transport packets that begin PES packets.

Reference is made to the MPEG-2 transport hint track in the Sample Description Atom (of type 'stsd'). This atom includes a sample description table, and the entries in this table differ based on the media type. In one example of the present invention, hint tracks begin with the structure shown in Table 1. The additional data table may hold entries with the structure shown in Table 2:

In one example of the present invention, if the hint track is an MPEG-2 transport hint track, the data format in the hint track sample description entry will be 'm2t' and the max packet size will always be 188. In such a description entry, the types shown below in Tables 5-7 may be found in the additional data table:

Table 5 - Additional Data Table Entries

Entry length	Data type	Data description
8	0x00000000	Indicates there are no more entries in the table
9	'otyp'	Describes how offsets are described in the hints. The one byte of data has values described below in figure B.4. *This entry is mandatory in the additional data table.*
9	'msns'	Describes the size of media sample numbers. The one byte of data indicates how many bytes are used to specify media sample numbers. If this is not present, and media sample numbers are present in the sample data, the default value is 4 bytes.
9	'msos'	Describes the size of media sample offsets. The one byte of data indicates how many bytes are used to specify media sample offsets. If this is not present, and media sample offsets are present in the sample data, the default value is 4 bytes.
9	'fosz'	Describes the size of file offsets. The one byte of data indicates how many bytes are used to specify file offsets within samples If this is not present, and file offsets are present in the sample data, the default value is 4 bytes.
Variable	'tmap'	Describes an abbreviated mapping of media tracks. Each 5 byte entry maps a 4 byte track ID to a 1 byte track reference number. This limits any given transport mux to containing no more than 256 media tracks, but this should not be a limiting factor, and this compression is useful in limiting the size of the hint track. The format of these 5 byte entries is specified below in figure B.5. *This entry is mandatory in the additional data table.*

Table 6- 'otyp' Values In the Additional Data Table

Value	Description
0	Samples are described in terms of media samples
1	Samples are described in terms of file offsets

Table 7 - Format of Entries in the 'tmap' Additional Data Entry

Length	Description
4	Original Track ID
1	Abbreviated track reference number used in samples

In one example of the present invention, each hint sample describes one transport packet. Each transport packet can be described as some amount of header data, followed by some amount of payload from one media track. Since MPEG-2 transport packets are relatively small, a large number of hint samples may be generated, and thus, these samples preferably should be as small as possible. Several entries in the additional data table above may be used to minimize the size of samples, but such factors may make some of the fields in the sample entries variable in size.

If the 'otyp' entry in the data table has the value 0, indicating that payload data is described in terms of media samples, hint samples may be of the following form shown in Table 8:

Table 8 - Hint Sample Format Using Media Sample References

Length	Description
1	**Track reference number of the media track holding the payload data for this packet. This can be mapped to a track ID using the 'tmap' entry in the additional data table. If the hint specifies 188 bytes of immediate data, this field is irrelevant.**
1	**The length of the immediate data for the packet. Note that this must be 188 or less, since transport packets are 188 bytes in length.**
Variable	**Bytes of immediate data to be used as the header for the transport packet. The number of bytes is described by the previous field.**
Variable	**The media sample number to use for the payload data. The default size of this field is 4 bytes, but may be modified by the presence of an 'msns' entry in the additional data table.**
Variable	**The media sample offset to use for the payload data. The default size of this field is 4 bytes, but may be modified by the presence of an 'msos' entry in the additional data table.**

In one example of the present invention, it is not necessary to indicate the length of the payload data for the packet since in MPEG-2, this length is equal to 188 minus the size of the header data for the packet.

If the 'otyp' entry in the data table has the value 1, indicating that payload data is described in terms of file offsets, hint samples may be of the following form shown in Table 9:

Table 9

Length	Description
1	**Track reference number of the media track holding the payload data for this packet. This can be mapped to a track ID using the 'tmap' entry in the additional data table. If the hint specifies 188 bytes of immediate data, this field is irrelevant.**
1	**The length of the immediate data for the packet. Note that this must be 188 or less since transport packets are 188 bytes in length.**
Variable	**Bytes of immediate data to be used as the header for the transport packet. The number of bytes is described by the previous field.**
Variable	**The file offset where the payload data is located. This offset is in the file where the data for the media track is located. The default size of this field is 4 bytes, but may be modified by the presence of an 'fosz' entry in the additional data table.**

In one example of the present invention, hint samples may describe their offsets in terms of media samples or in terms of file offsets. Each of these has advantages and disadvantages. If hint samples specify payload in terms of media samples, they may be more resilient to additional editing of the file containing the media track, but may require additional processing for delivery. If hint samples specify payload in terms of file offsets, the payload data can be accessed relatively quickly, but any editing of the file containing the media track may invalidate the hints.

Appendix D — An example file

Provided below is a relatively short (six frame) sample file, with some of the relatively less important fields and objects left out (marked here by ellipsis "..."), and with some fictitious numbers to illustrate the overall structure of a file which is ready for streaming over RTP, according to one embodiment of the present invention. The media data has been left out; only the meta-data is shown.

```
moov -- the entire movie meta-data
  mvhd -- overall movie information
     …
     TIME-SCALE            600
     DURATION              2792
     PREFERRED-RATE        1
     VOLUME                255
     MATRIX                [[1 0 0] [0 1 0] [0 0 1]]
     …
     NEXT-TRACK-ID         5 -- tracks 1 to 4 are here
  trak -- this is the video track
    tkhd
       …
       TRACK-ID            1
       DURATION            2792
       LAYER               0
       …
       MATRIX              [[1 0 0] [0 1 0] [0 0 1]]
       WIDTH               176
       HEIGHT              144
    mdia
      mdhd
         …
         TIME-SCALE          600
         DURATION            2722
         …
      hdlr -- we use the basic video media handler
         …
         TYPE                mhlr
         SUBTYPE             vide
         MANUFACT            appl
         …
         NAME                Apple Video Media Handler
      minf
        vmhd
           …
        hdlr -- basic 'alias' disk data handler gets the data
           …
           TYPE                dhlr
           SUBTYPE             alis
           MANUFACT            appl
           …
           NAME                Apple Alias Data Handler
        dinf
          dref
             …
             ENTRY-COUNT         1
             REFS                [Pointer to this file]
        stbl -- the complete sample table
          stsd -- the sample description(s)
```

```
                ...
                ENTRY-COUNT          1
                DESCRIPTIONS         [video sample description]
             stts -- convert time to sample
                ...
                ENTRY-COUNT          6
                TIMETOSAMPLE         ((1 200) -- count, duration
                                      (1 251)
                                      (1 479)
                                      (1 531)
                                      (1 1022)
                                      (1 239))
             stss -- 'sync' or key sample numbers
                ...
                ENTRY-COUNT          1
                SYNCSAMPLES          (1)
             stsc -- sample to chunk
                ...
                ENTRY-COUNT          1
                SAMPLETOCHUNK        ((1 1 1))
                  -- 1st chunk, samples/chunk, desc. number
             stsz -- sample sizes
                ...
                DEFSAMPLESIZE        0 -- no default size, all
different
                ENTRY-COUNT          6
                SAMPLESIZES          (664
                                      616
                                      1176
                                      1304
                                      2508
                                      588)
             stco -- chunk offsets into file
                ...
                ENTRY-COUNT          6
                CHUNKOFFSETS         (4743
                                      5407
                                      8010
                                      12592
                                      17302
                                      25268)
  trak -- this is the sound track
    tkhd
       ...
       TRACK-ID             2
       DURATION             2792
       ...
       VOLUME               1
       ...
    mdia
      mdhd
```

```
      …
      TIME-SCALE          8000
      DURATION            37280
      LANGUAGE            US English
      …
   hdlr -- handled by the basic sound handler
      …
      TYPE                mhlr
      SUBTYPE             soun
      MANUFACT            appl
      …
      NAME                Apple Sound Media Handler
   minf
     smhd
        …
        BALANCE             0
     hdlr -- data fetched by usual disc data handler
        …
        TYPE                dhlr
        SUBTYPE             alis
        MANUFACT            appl
        …
        NAME                Apple Alias Data Handler
     dinf
       dref
          …
          ENTRY-COUNT       1
          REFS              [Pointer to this file]
     stbl -- sample table for the sound
       stsd -- sample descriptions
          …
          ENTRY-COUNT       1
          DESCRIPTIONS      [Sound sample description, incl
GSM]
       stts -- time to sample table
          … -- sound is measured by uncompressed samples
          ENTRY-COUNT       1
          TIMETOSAMPLE      ((37280 1))
       stsc
          …
          ENTRY-COUNT       2
          SAMPLETOCHUNK     ((1 4000 1)
                             (10 1280 1))
           -- first chunk, samples/chunk, desc. number
       stsz
          …
          DEFSAMPLESIZE     1 -- all samples same size
          ENTRY-COUNT       37280
       stco -- chunk offset table
          …
          ENTRY-COUNT       10
```

```
            CHUNKOFFSETS          (3093
                                   3918
                                   6023
                                   9186
                                   10915
                                   13896 ...)
trak -- the RTP hints for the video track
  tkhd
     …
     TRACK-ID              3
     DURATION              2792
     …
  tref
    hint -- references the video track
       TRACKIDS            (1)
  mdia
    mdhd
       …
       TIME-SCALE          600
       DURATION            2792
       …
    hdlr -- is 'played' by the hint media handler
       …
       TYPE                mhlr
       SUBTYPE             hint
       MANUFACT            appl
       …
       NAME                hint media handler
    minf
      gmhd
          …
      hdlr -- if played, the regular disc handler would fetch data
         …
         TYPE               dhlr
         SUBTYPE            alis
         MANUFACT           appl
         …
         NAME               Apple Alias Data Handler
      dinf
        dref
           …
           ENTRY-COUNT      1
           REFS             [Pointer to this file]
      stbl -- samples describe packets
        stsd
           …
           ENTRY-COUNT      1
           DESCRIPTIONS     [hint sample description]
        stts -- one packet per frame for video
           …
           ENTRY-COUNT      6
```

```
            TIMETOSAMPLE          ((1 270)
                                   (1 251)
                                   (1 479)
                                   (1 531)
                                   (1 1022)
                                   (1 239))
         stss -- key sample derive from video
            ...
            ENTRY-COUNT           1
            SYNCSAMPLES           (1)
         stsc -- sample to chunk table
            ...
            ENTRY-COUNT           1
            SAMPLETOCHUNK         ((1 1 1))
         stsz -- sample sizes (packet instructions)
            ...
            DEFSAMPLESIZE         0
            ENTRY-COUNT           6
            SAMPLESIZES           (52
                                   52
                                   52
                                   52
                                   102
                                   52)
         stco -- chunk offsets
            ...
            ENTRY-COUNT           6
            CHUNKOFFSETS          (6848
                                   6900
                                   10011
                                   14721
                                   20635
                                   25856)
   udta -- track is named for ease of idientification
     name
        NAME                      Hinted Video Track
trak -- the RTP hints for the sound track
   tkhd
      ...
      TRACK-ID              4
      ...
   tref -- references the sound track
     hint
        TRACKIDS              (2)
   mdia
     mdhd
        ...
        TIME-SCALE            8000
        DURATION              37120
        ...
     hdlr
```

```
    …
    TYPE                    mhlr
    SUBTYPE                 hint
    MANUFACT                appl
    …
    NAME                    hint media handler
minf
  gmhd
    …
  hdlr
      …
      TYPE                    dhlr
      SUBTYPE                 alis
      MANUFACT                appl
      …
      NAME                    Apple Alias Data Handler
  dinf
    dref
       …
       ENTRY-COUNT            1
       REFS                   [Pointer to this file]
  stbl
    stsd
       …
       ENTRY-COUNT            1
       DESCRIPTIONS           [hint sample description]
    stts -- time to sample
       …
       ENTRY-COUNT            4
       TIMETOSAMPLE           ((1 960)
                               (7 4000)
                               (1 1120)
                               (1 7040))
    stsc
       …
       ENTRY-COUNT            1
       SAMPLETOCHUNK          ((1 1 1))
    stsz
       …
       DEFSAMPLESIZE          0
       ENTRY-COUNT            10
       SAMPLESIZES            (206
                               852
                               852
                               852
                               852
                               852 ...)
    stco
       …
       ENTRY-COUNT            10
       CHUNKOFFSETS           (6952
```

```
                                    7158
                                    10063
                                    11740
                                    14773
                                    16450 ...)
udta
     NAME                           Hinted Sound Track
```

CLAIMS

What is claimed is:

1. A method implemented by a digital processing system for processing media data, said method comprising:

creating on a first digital processing system a set of data to indicate how to transmit a time related sequence of media data according to a transmission protocol; and

storing said set of data on a storage device coupled to the first digital processing system, wherein said set of data is a time related sequence of data associated with and separate from said time related sequence of media data.

2. A method as in claim 1 wherein said set of data is stored as a track of indicating data, and wherein said transmission protocol comprises a packet data protocol.

3. A method as in claim 1 further comprising:

determining a format of said time related sequence of media data before creating said set of data;

determining said transmission protocol before creating said set of data, wherein said transmission protocol is used to transmit said time related sequence of media data which has said format.

4. A method as in claim 1 further comprising:

transmitting packets of data representing said time related sequence of media data according to said transmission protocol.

5. A method as in claim 4 further comprising:

transmitting said set of data to a second digital processing system, which second digital processing system, in response to receiving said set of data, generates said packets of data.

6. A method as in claim 4 wherein for each of said packets, said set of data refers to data in at least one of a sequence of image data or a sequence of audio data associated with said time related sequence of media data.

7. A method as in claim 5 wherein said first digital processing system provides said set of data to a server digital processing system which stores said set of data and transmits said packets of data to a receiving digital processing system.

8. A machine readable medium containing executable program instructions, which when executed on a digital processing system cause the digital processing system to perform a method comprising:

retrieving a set of data which indicates how to transmit a time related sequence of media data according to a transmission protocol;

transmitting data representative of said time related sequence of media data according to said set of data, wherein said set of data is a time related sequence of data associated with and separate from said time related sequence of media data.

9. The machine readable medium of claim 8, wherein said set of data is stored as a track of indicating data, and wherein said transmission protocol comprises a packet data protocol.

10. The machine readable medium of claim 8, wherein execution of said executable program instructions further cause said digital processing system to perform the method comprising:

determining a format of said time related sequence of media data;

determining said transmission protocol, wherein said transmission protocol is used to transmit said time related sequence of media data which has said format.

11. The machine readable medium of claim 10, wherein execution of said executable program instructions further cause said digital processing system to perform the method comprising:

transmitting packets of data representing said time related sequence of media data according to said transmission protocol.

12. The machine readable medium of claim 11, wherein for each of said packets, said set of data refers to data in at least one of a sequence of image data or a sequence of audio data associated with said time related sequence of media data.

13. The machine readable medium of claim 8, comprising a magnetic storage area, wherein at least one of said executable program instructions and said time related sequence of media data is stored in said magnetic storage area.

14. The machine readable medium of claim 8, comprising an optical storage area, wherein at least one of said executable program instructions and said time related sequence of media data is stored in said optical storage area.

15. The machine readable medium of claim 8, comprising an electronic storage area, wherein at least one of said executable program instructions and said time related sequence of media data is stored in said electronic storage area.

16. An apparatus comprising:

a first digital processing system comprising a first processor to generate a set of data associated with transmission of a time related sequence of media data according to a transmission protocol, wherein said set of data is a time related sequence of data associated with and separate from said time related sequence of media data.

17. The apparatus of claim 16, further comprising:

a second digital processing system, coupled to said first digital processing system, to receive said set of data from said first digital processing system, said second processor comprising:

a second processor;

a first storage area to store said media data; and

a second storage area to store said set of data.

18. The apparatus of claim 17, wherein said second digital processing system is coupled to a data communication link to provide packets of data representing said time related sequence of media data according to said transmission protocol.

19. The apparatus of claim 18, wherein for each of said packets, said set of data refers to data in at least one of a sequence of image data or a sequence of audio data associated with said time related sequence of media data.

20. A computer readable medium comprising:

a time related sequence of media data;

a set of data which, when processed by a digital processing system, indicates to said digital processing system how to transmit said time related sequence of media data according to a transmission protocol, wherein said set of data is a time related sequence of data associated with and separate from said time related sequence of media data.

21. The computer readable medium of claim 20, wherein said set of data is stored as a track of indicating data, and wherein said transmission protocol comprises a packet data protocol.

22. The computer readable medium of claim 20, further comprising:

a first set of instructions to cause a digital processing system to determine a format of said time related sequence of media data;

a second set of instructions to cause said digital processing system to determine said transmission protocol, wherein said transmission protocol is used to transmit said time related sequence of media data which has said format.

23. The computer readable medium of claim 22, wherein said set of data is stored as a track of indicating data, and wherein said transmission protocol comprises a packet data protocol.

24. The computer readable medium of claim 21, further comprising a set of instructions to cause a digital processing system to generate packets representing said time related sequence of media data, wherein for each of said packets, said set of data refers to data in at least one of a sequence of image data and a sequence of audio data associated with said time related sequence of media data.

25. The computer readable medium of claim 20, comprising a magnetic storage area, wherein at least one of said time related sequence of media data and said set of data is stored in said magnetic storage area.

26. The computer readable medium of claim 20, comprising an optical storage area, wherein at least one of said time related sequence of media data and set of instructions is stored in said optical storage area.

27. The computer readable medium of claim 20, comprising an electronic storage area, wherein at least one of said time related sequence of media data and said set of data is stored in said electronic storage area.

28. A computer readable medium containing executable computer program instructions, which when executed on a first digital processing system cause the first digital processing system to perform a method comprising:

generating a set of data to indicate a method to transmit a time related sequence of media data according to a transmission protocol, wherein said set of data is a time related sequence of data associated with and separate from said time related sequence of media data; and

storing said set of data.

29. The computer readable medium of claim 28, wherein said set of data is stored as a track of indicating data, and wherein said transmission protocol comprises a packet data protocol.

30. The machine readable medium of claim 28, wherein said executable program instructions further cause the first digital processing system to perform the method comprising:

determining a format of said time related sequence of media data;

determining said transmission protocol, wherein said transmission protocol is used to transmit said time related sequence of media data which has said format.

31. The machine readable medium of claim 28, wherein said executable program instructions further cause the first digital processing system to perform the method comprising:

generating packets of data representing said time related sequence of media data according to said transmission protocol; and

transmitting said packets to a second digital processing system.

32. The machine readable medium of claim 28, wherein said executable program instructions further cause the digital processing system to perform the method comprising:

transmitting said set of data to a second digital processing system, wherein said second digital processing system utilizes said set of data to generate packets of data representing said time related sequence of media data according to said transmission protocol.

33. The machine readable medium of claim 31, wherein for each of said packets, said set of data refers to data in at least one of a sequence of image data and a sequence of audio data associated with said time related sequence of media data.

34. The machine readable medium of claim 22, wherein for each of said packets, said set of data refers to data in at least one of said sequence of image data and said sequence of audio data.

35. The machine readable medium of claim 32, wherein said second digital processing system, in response to said set of data, transmits said packets of data to another digital processing system.

36. An apparatus for processing media data, said apparatus comprising:

a first means for generating a set of data associated with transmission of a time related sequence of media data according to a transmission protocol, wherein said set of data is a time related sequence of data associated with and separate from said time related sequence of media data; and

a second means for storing said first set of data.

37. The apparatus of claim 36, further comprising:
a third means for transmitting packets of data representing said time related sequence of media data.

38. The apparatus of claim 37, wherein said set of data identifies at least a portion of said packets of data.

39. The apparatus of claim 37, wherein said set of data provides at least a portion of the information included in said packets of data.

40. The apparatus of claim 37, further comprising:
a third means for transmitting said set of data to a server means, said server means having means for generating packets of data representing said time related sequence of media data for transmission to a receiver means.

41. A method of processing media data, said method comprising:
storing a time related sequence of media data;
storing a set of data to enable a first digital processing system to generate, according to a transmission protocol, data packets representing said time related sequence of media data, wherein said set of data is a time

related sequence of data associated with said time related sequence of media data.

42. The method of claim 41, wherein said set of data provides at least a portion of the information included in said data packets.

43. The method of claim 41, wherein said set of data identifies at least a portion of the information included in said data packets.

44. The method of claim 41, further comprising:

generating said set of data at a second digital processing system;

said second digital processing system transmitting said set of data to said first digital processing system; and

said first digital processing system generating said data packets in response to receiving said set of data.

45. The method of claim 44, further comprising:

said first digital processing system transmitting said data packets to another digital processing system for presentation as a media object.

46. A method implemented by a digital processing system for processing media data, said method comprising:

generating on a first digital processing system a first time related sequence of data to indicate how to transmit a second time related sequence of data according to a transmission protocol, wherein said second time related sequence of data is associated with time-based media, and wherein said first time related sequence of data is associated with said second time related sequence of data; and

storing said first time related sequence of data.

47. A method as in claim 46, wherein said first time related sequence of data is stored as a track of indicating data, and wherein said transmission protocol comprises a packet data protocol.

48. A method as in claim 46, further comprising:

determining a format of said second time related sequence of data prior to generating said first time related sequence of data; and

determining said transmission protocol prior to generating said first time related sequence of data, wherein said transmission protocol is used to transmit said second time related sequence of data which has said format.

49. A method as in claim 46, further comprising:

transmitting packets of data representing said second time related sequence of data according to said transmission protocol.

50. A method as in claim 49, further comprising:

transmitting said first time related sequence of data to a second digital processing system, which second digital processing system, in response to receiving said first time related sequence of data, generates said packets of data.

51. A method as in claim 49, wherein for each of said packets, said first time related sequence of data refers to at least one of a sequence of image data or a sequence of audio data associated with said second time related sequence of data.

52. A method as in claim 50, wherein said first digital processing system provides said first time related sequence of data to a server digital processing system which stores said first time related sequence of data and transmits said packets of data to a receiving digital processing system.

53. A method as in claim 50, further comprising presenting said time related sequence of media data on at least one of said first digital processing system and said second digital processing system.

54. A method as in claim 46, wherein said second time related sequence of data is stored on a read-only memory (ROM).

55. A method as in claim 54, wherein said read-only memory (ROM) comprises a optical storage medium.

56. A method as in claim 54, wherein said second time related sequence of data is packetized according to said first time related sequence of data without performing at least one of a storing and a formatting operation on said second time related sequence of data.

ABSTRACT OF THE DISCLOSURE

Methods and apparatuses for processing media data for transmission in a data communication medium. A set of data indicates how to transmit a time related sequence of media data according to a transmission protocol. The set of data, includes a time related sequence of data which is associated with the time related sequence of media data. The set of data may be utilized by a digital processing system to transmit the time related sequence of media data (e.g., by packets generated according to the transmission protocol and the set of data).

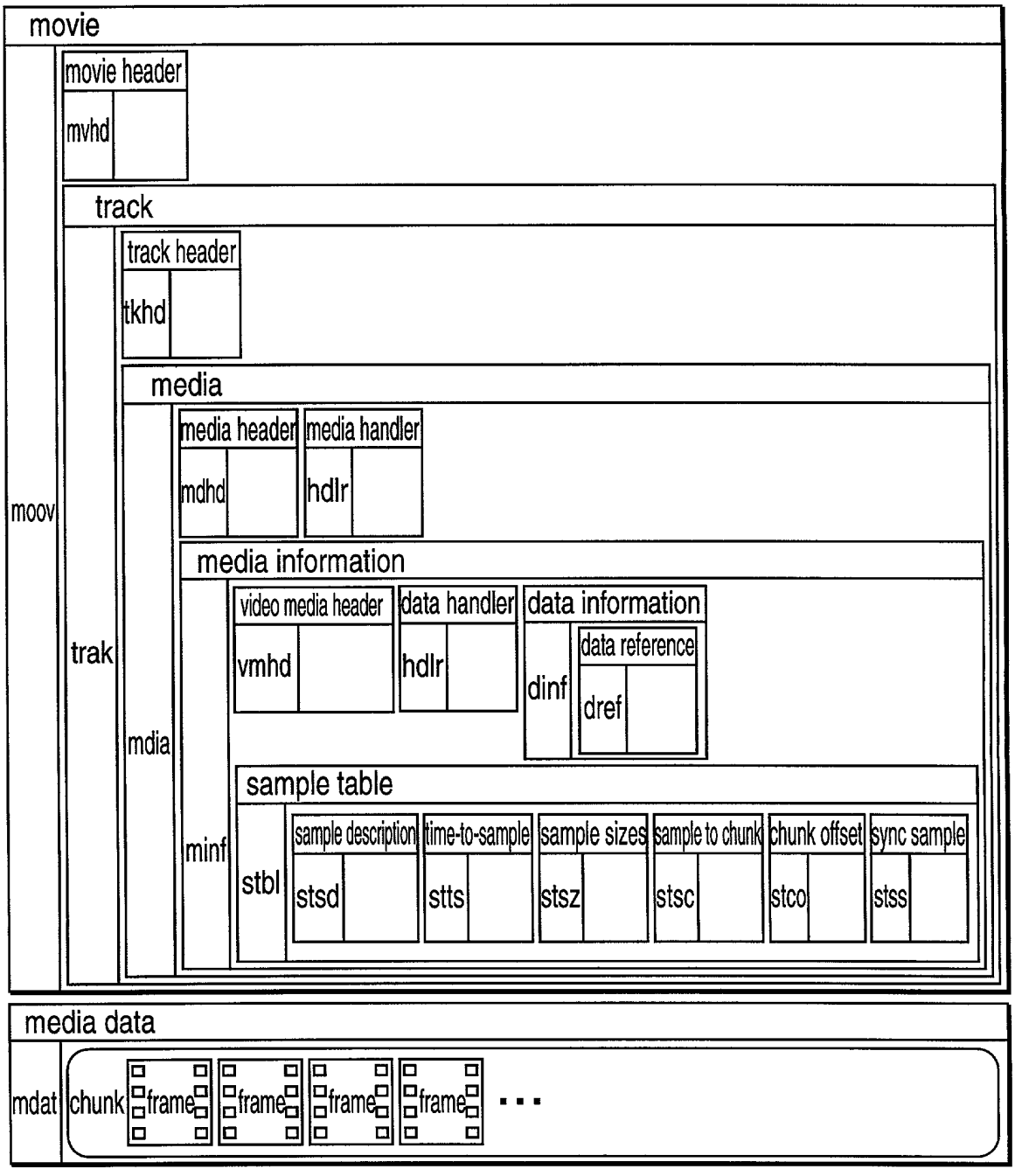

movie
moov
movie header
mvhd
track
trak
track header
tkhd
media
mdia
media header
mdhd
media handler
hdlr
media information
minf
video media header
vmhd
data handler
hdlr
data information
dinf
data reference
dref
sample table
stbl
sample description
stsd
time-to-sample
stts
sample sizes
stsz
sample to chunk
stsc
chunk offset
stco
sync sample
stss
media data
mdat
chunk
frame
frame
frame
frame
...

FIG. 1

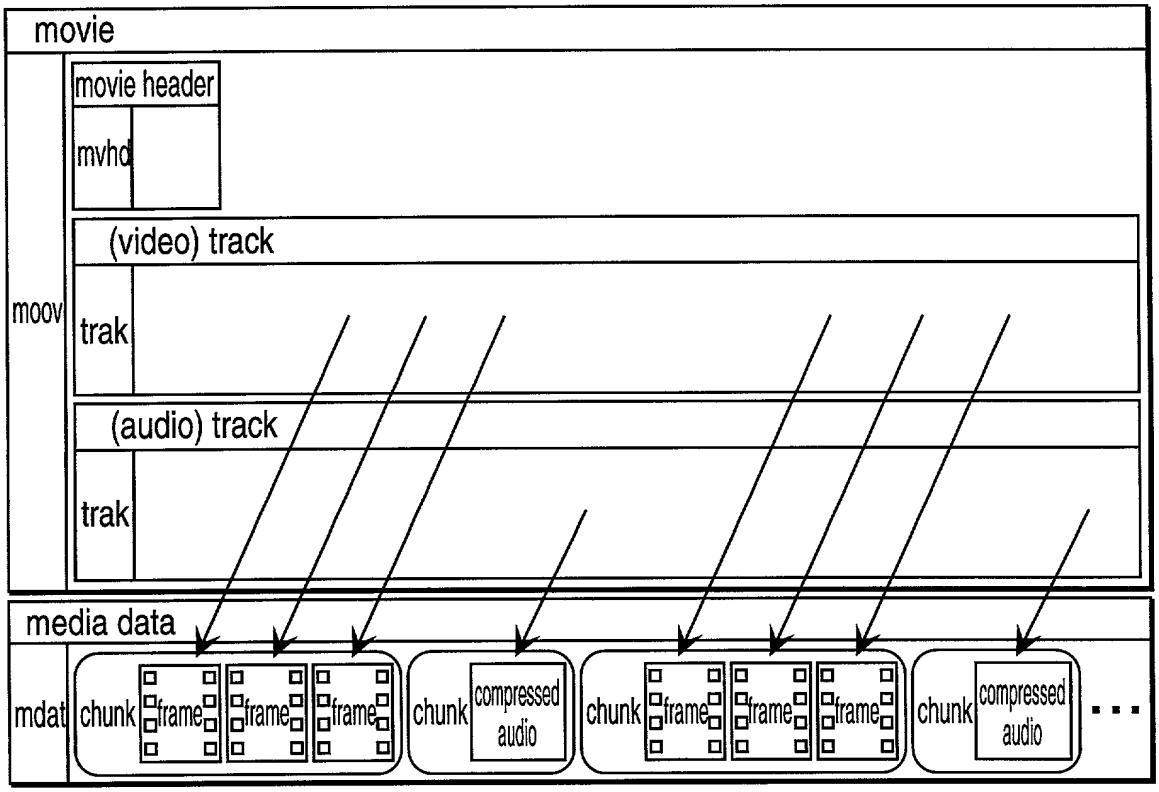

movie
moov
movie header
mvhd
(video) track
trak
(audio) track
trak
media data
mdat
chunk
frame
frame
frame
chunk
compressed audio
chunk
frame
frame
frame
chunk
compressed audio
...

FIG. 2

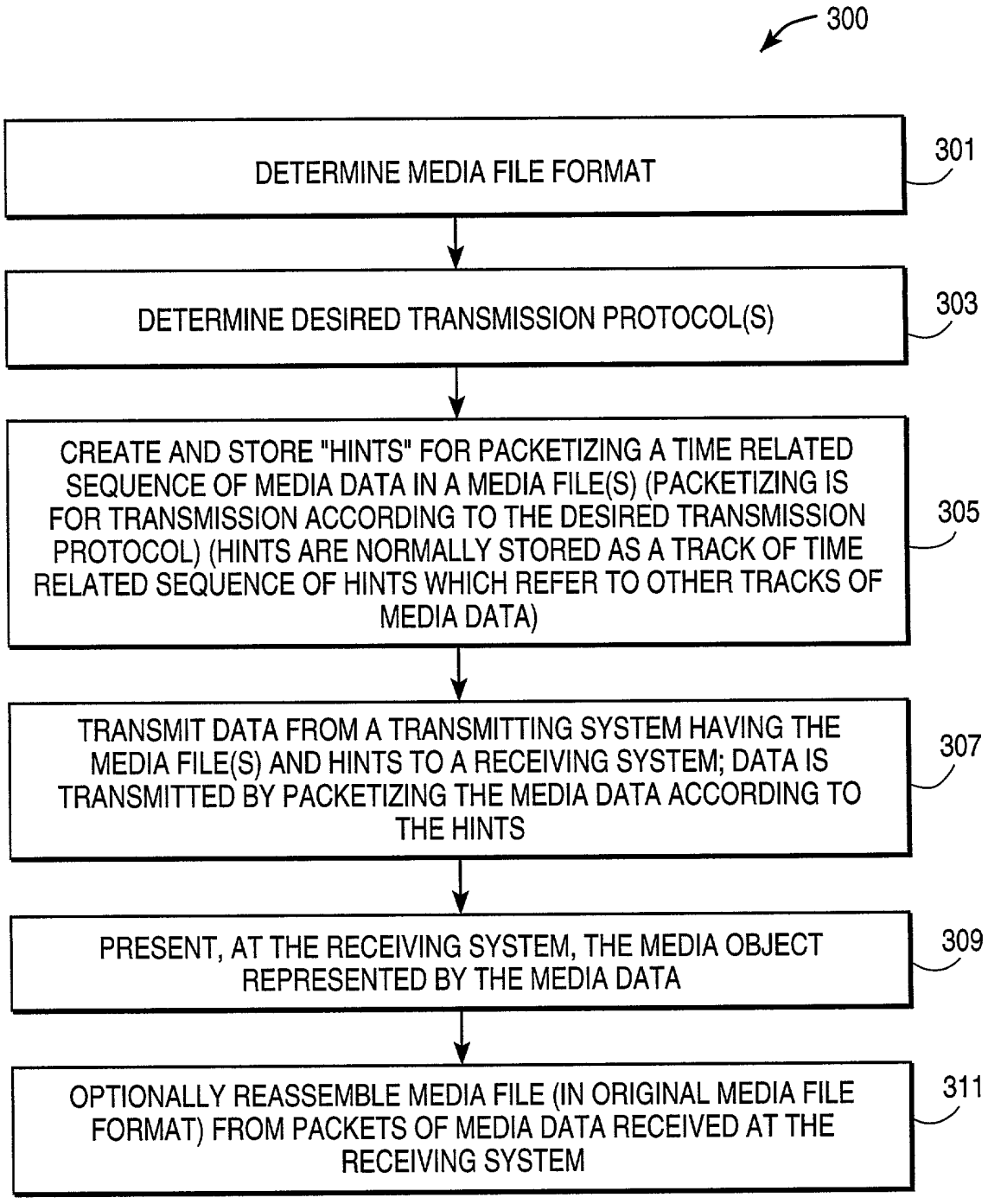

300
DETERMINE MEDIA FILE FORMAT
301
DETERMINE DESIRED TRANSMISSION PROTOCOL(S)
303
CREATE AND STORE "HINTS" FOR PACKETIZING A TIME RELATED SEQUENCE OF MEDIA DATA IN A MEDIA FILE(S) (PACKETIZING IS FOR TRANSMISSION ACCORDING TO THE DESIRED TRANSMISSION PROTOCOL) (HINTS ARE NORMALLY STORED AS A TRACK OF TIME RELATED SEQUENCE OF HINTS WHICH REFER TO OTHER TRACKS OF MEDIA DATA)
305
TRANSMIT DATA FROM A TRANSMITTING SYSTEM HAVING THE MEDIA FILE(S) AND HINTS TO A RECEIVING SYSTEM; DATA IS TRANSMITTED BY PACKETIZING THE MEDIA DATA ACCORDING TO THE HINTS
307
PRESENT, AT THE RECEIVING SYSTEM, THE MEDIA OBJECT REPRESENTED BY THE MEDIA DATA
309
OPTIONALLY REASSEMBLE MEDIA FILE (IN ORIGINAL MEDIA FILE FORMAT) FROM PACKETS OF MEDIA DATA RECEIVED AT THE RECEIVING SYSTEM
311

FIG. 3

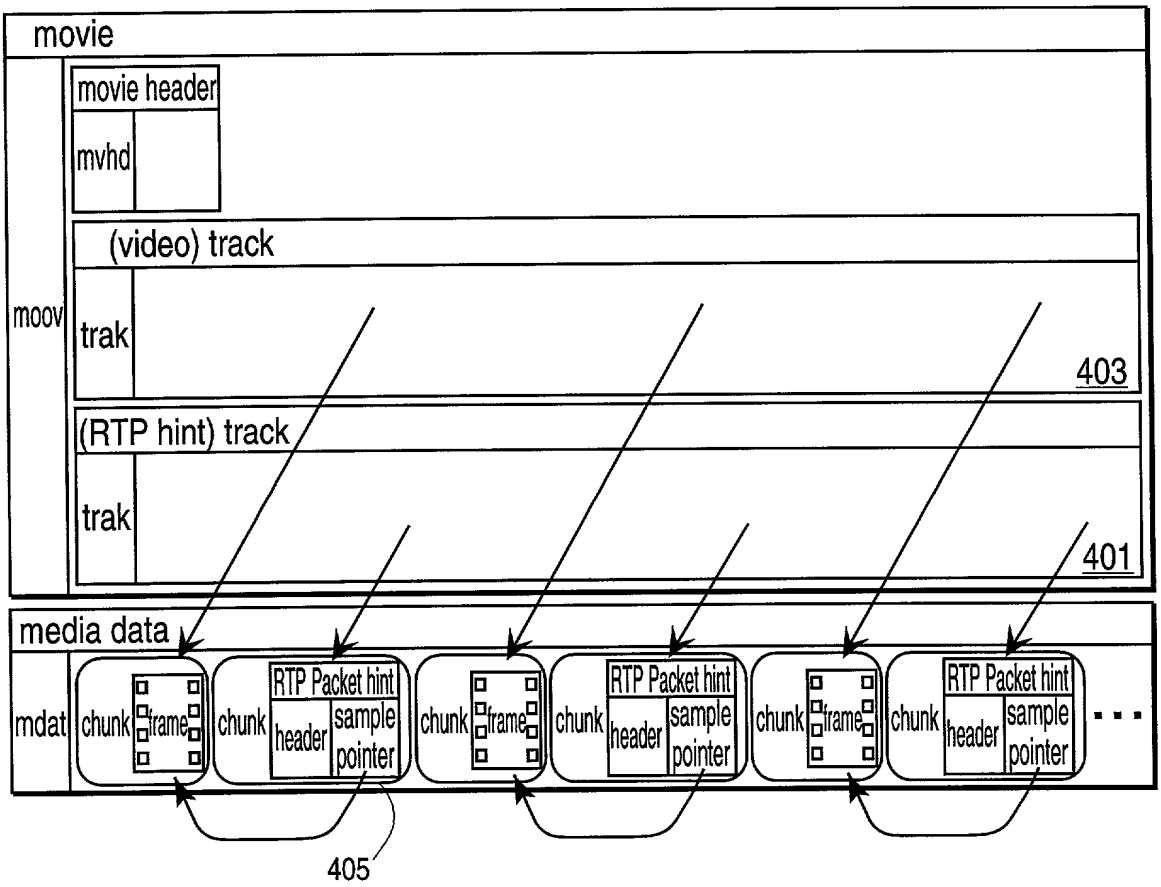

movie
moov
movie header
mvhd
(video) track
trak
403
(RTP hint) track
trak
401
media data
mdat
chunk
frame
chunk
RTP Packet hint
header
sample pointer
chunk
frame
chunk
RTP Packet hint
header
sample pointer
chunk
frame
chunk
RTP Packet hint
header
sample pointer
405

FIG. 4

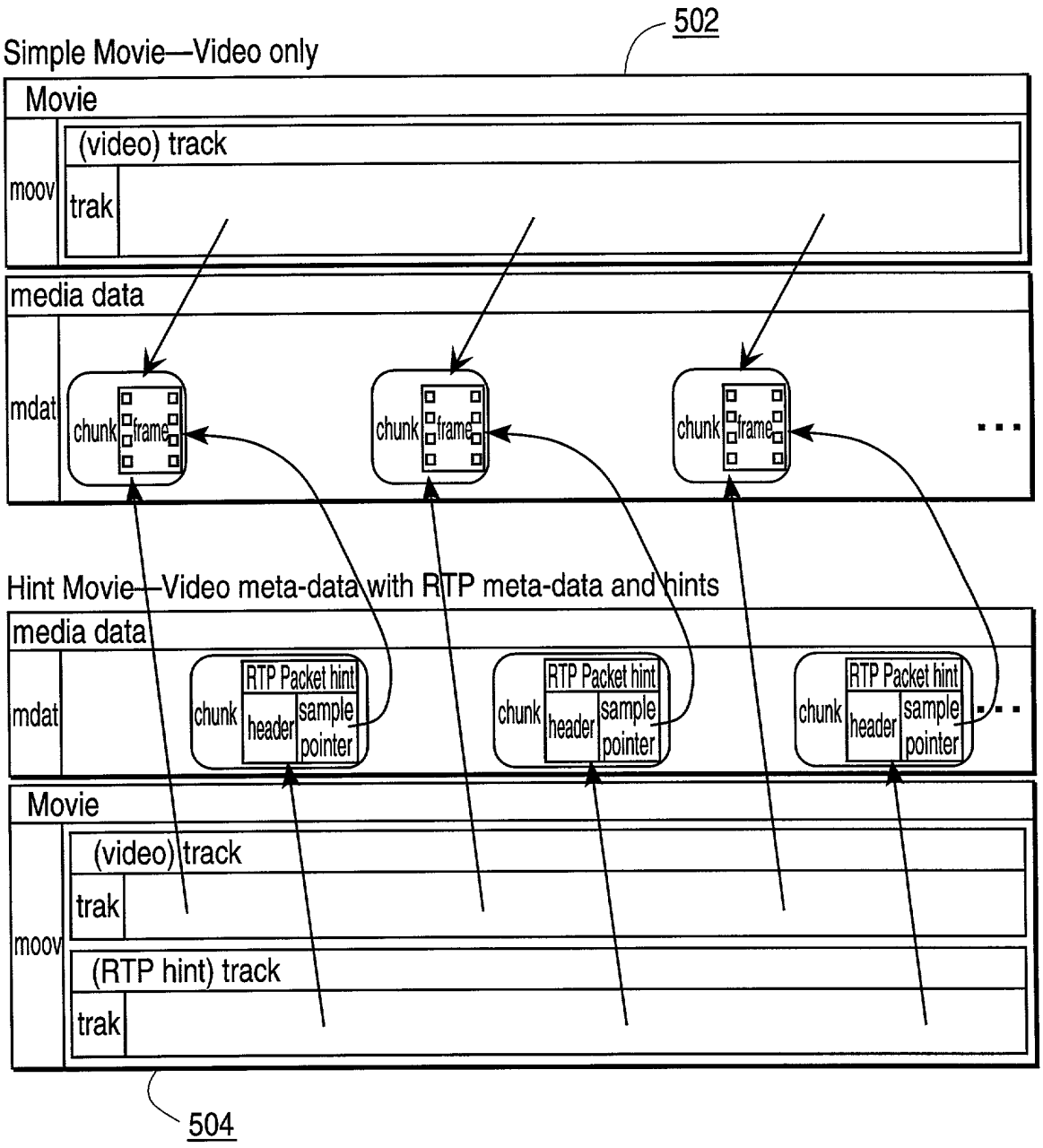

502
Simple Movie—Video only
Movie
moov
(video) track
trak
media data
mdat
chunk
frame
Hint Movie—Video meta-data with RTP meta-data and hints
media data
mdat
chunk
RTP Packet hint
header
sample pointer
Movie
moov
(video) track
trak
(RTP hint) track
trak
504

FIG. 5

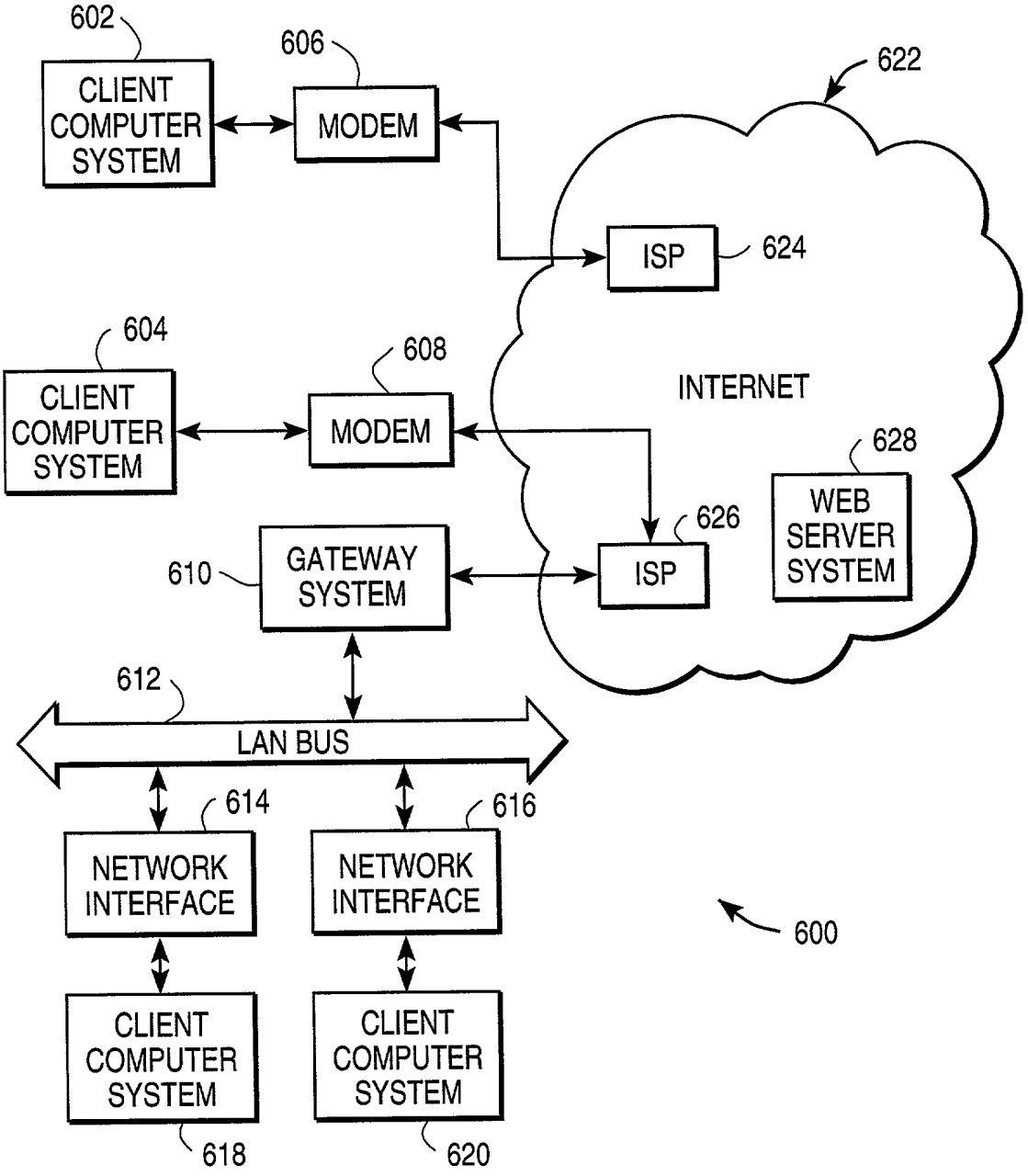

602
CLIENT COMPUTER SYSTEM
606
MODEM
622
ISP
624
604
CLIENT COMPUTER SYSTEM
608
MODEM
INTERNET
628
WEB SERVER SYSTEM
626
ISP
610
GATEWAY SYSTEM
612
LAN BUS
614
NETWORK INTERFACE
616
NETWORK INTERFACE
600
CLIENT COMPUTER SYSTEM
618
CLIENT COMPUTER SYSTEM
620

FIG. 6

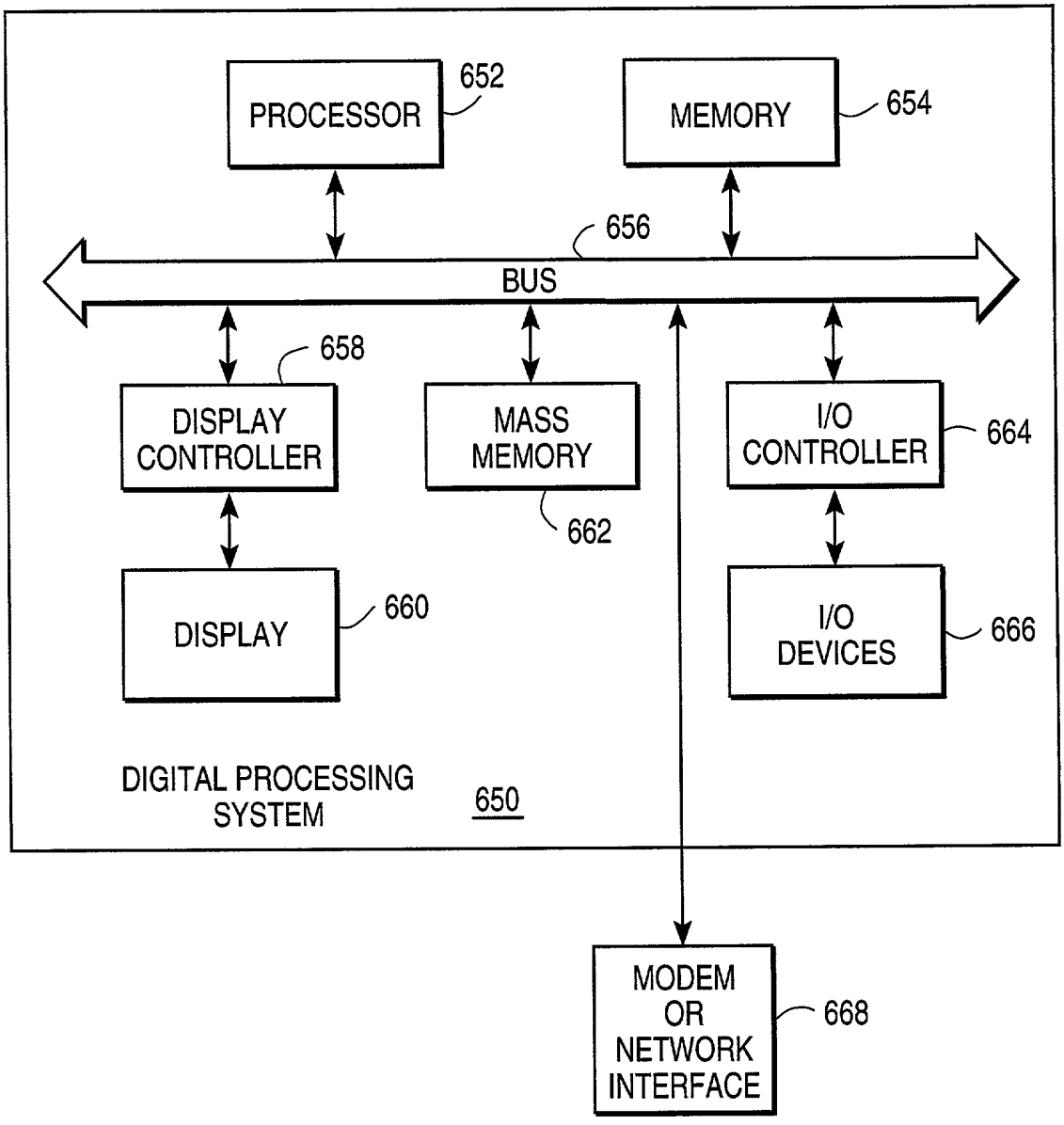

PROCESSOR
652
MEMORY
654
656
BUS
658
DISPLAY CONTROLLER
MASS MEMORY
662
I/O CONTROLLER
664
DISPLAY
660
I/O DEVICES
666
DIGITAL PROCESSING SYSTEM
650
MODEM OR NETWORK INTERFACE
668

FIG. 7

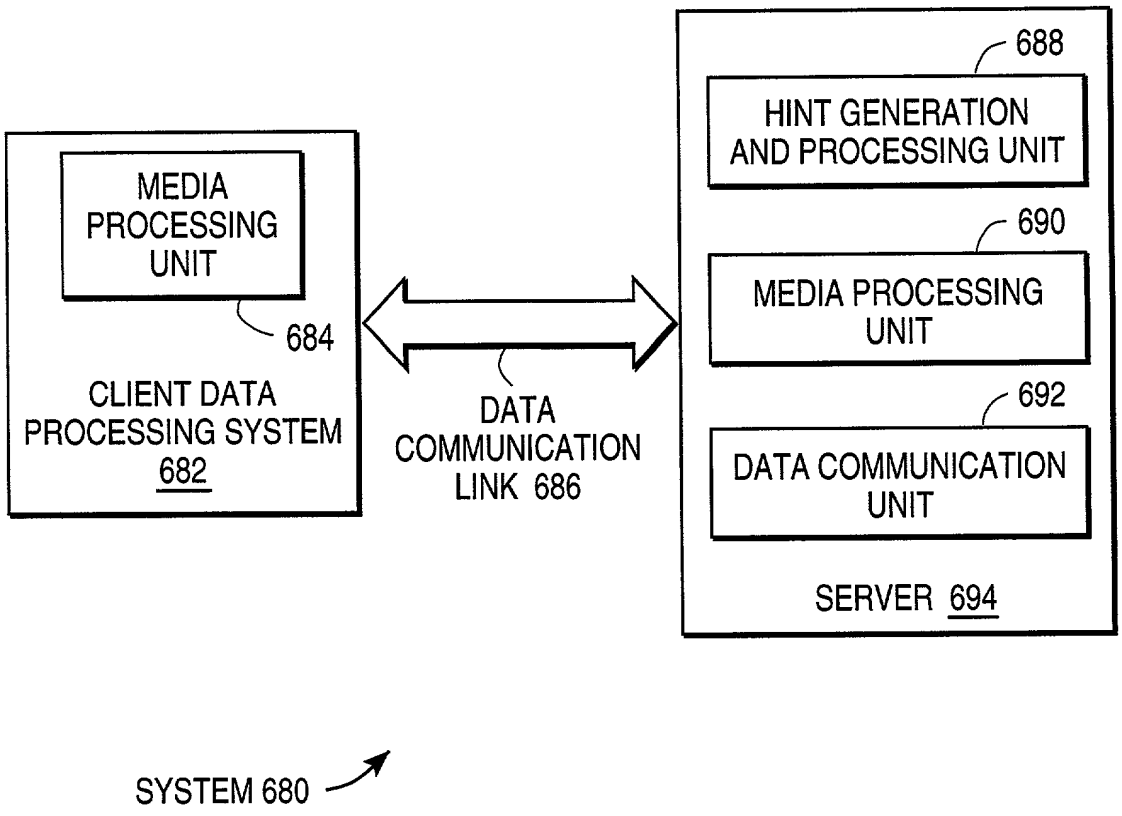

MEDIA PROCESSING UNIT
684
CLIENT DATA PROCESSING SYSTEM 682
DATA COMMUNICATION LINK 686
688
HINT GENERATION AND PROCESSING UNIT
690
MEDIA PROCESSING UNIT
692
DATA COMMUNICATION UNIT
SERVER 694
SYSTEM 680

FIG. 8

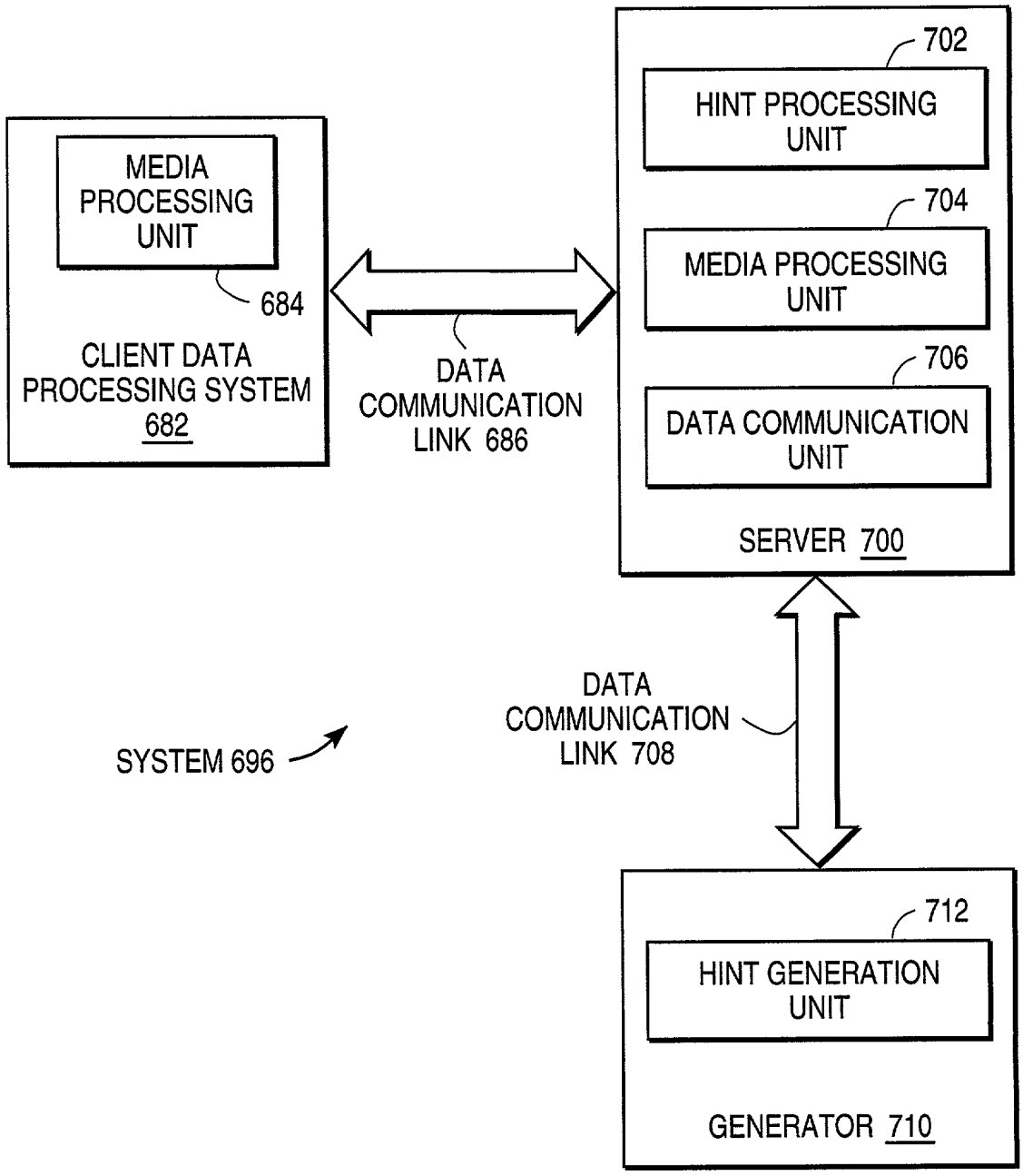

MEDIA PROCESSING UNIT
684
CLIENT DATA PROCESSING SYSTEM 682
DATA COMMUNICATION LINK 686
702
HINT PROCESSING UNIT
704
MEDIA PROCESSING UNIT
706
DATA COMMUNICATION UNIT
SERVER 700
SYSTEM 696
DATA COMMUNICATION LINK 708
712
HINT GENERATION UNIT
GENERATOR 710

FIG. 9

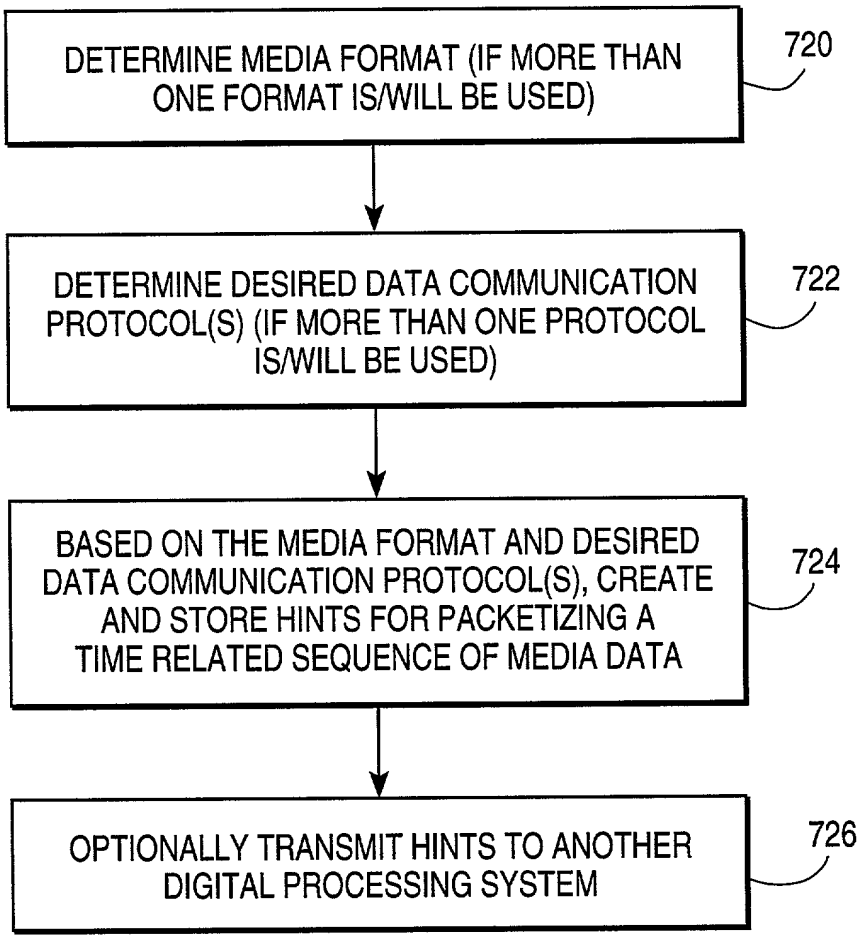

DETERMINE MEDIA FORMAT (IF MORE THAN ONE FORMAT IS/WILL BE USED)
720
DETERMINE DESIRED DATA COMMUNICATION PROTOCOL(S) (IF MORE THAN ONE PROTOCOL IS/WILL BE USED)
722
BASED ON THE MEDIA FORMAT AND DESIRED DATA COMMUNICATION PROTOCOL(S), CREATE AND STORE HINTS FOR PACKETIZING A TIME RELATED SEQUENCE OF MEDIA DATA
724
OPTIONALLY TRANSMIT HINTS TO ANOTHER DIGITAL PROCESSING SYSTEM
726

FIG. 10

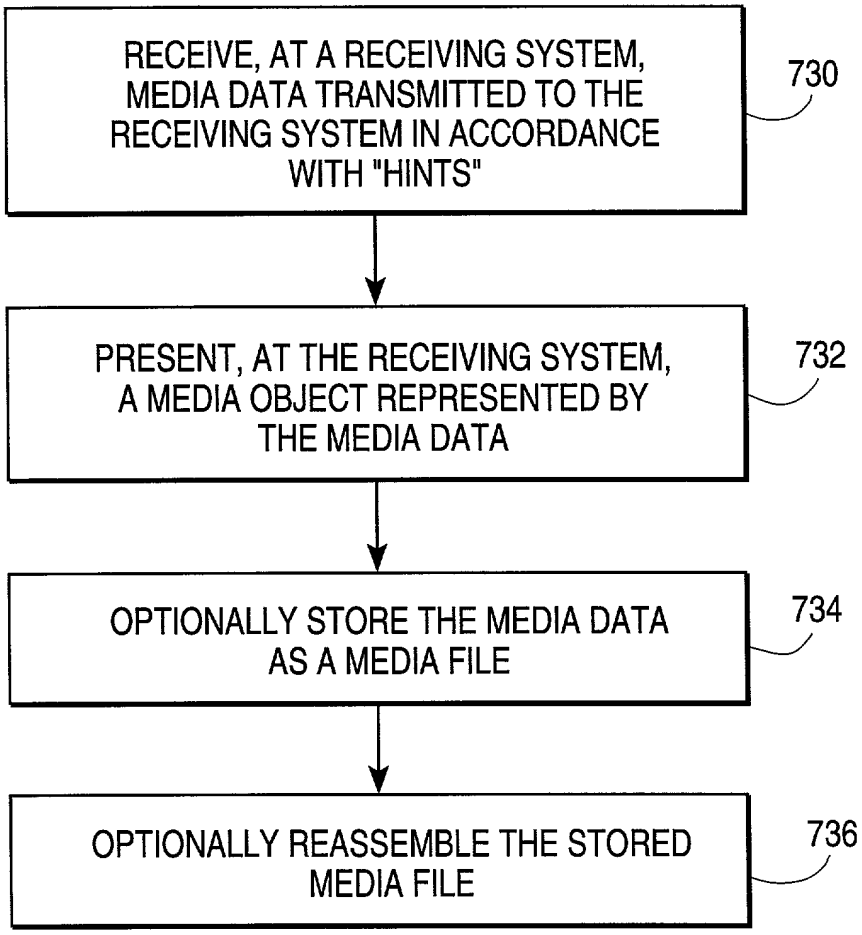

RECEIVE, AT A RECEIVING SYSTEM, MEDIA DATA TRANSMITTED TO THE RECEIVING SYSTEM IN ACCORDANCE WITH "HINTS"
730
PRESENT, AT THE RECEIVING SYSTEM, A MEDIA OBJECT REPRESENTED BY THE MEDIA DATA
732
OPTIONALLY STORE THE MEDIA DATA AS A MEDIA FILE
734
OPTIONALLY REASSEMBLE THE STORED MEDIA FILE
736

FIG. 11

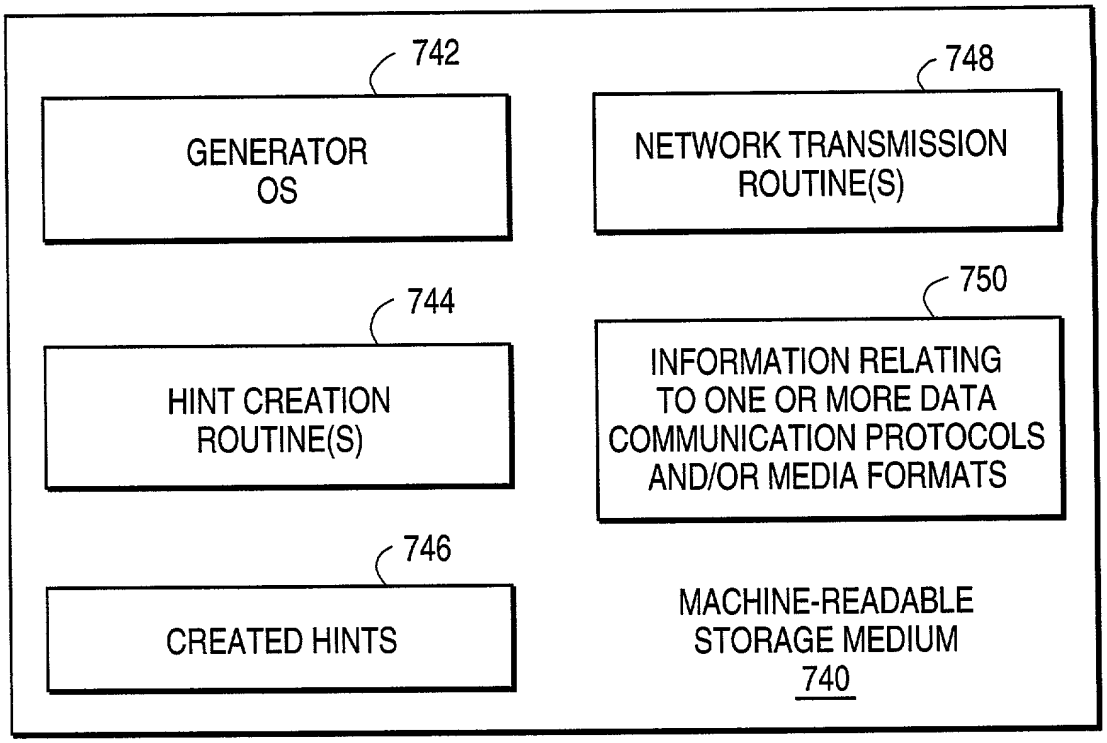

742
GENERATOR OS
748
NETWORK TRANSMISSION ROUTINE(S)
744
HINT CREATION ROUTINE(S)
750
INFORMATION RELATING TO ONE OR MORE DATA COMMUNICATION PROTOCOLS AND/OR MEDIA FORMATS
746
CREATED HINTS
MACHINE-READABLE STORAGE MEDIUM
740

FIG. 12

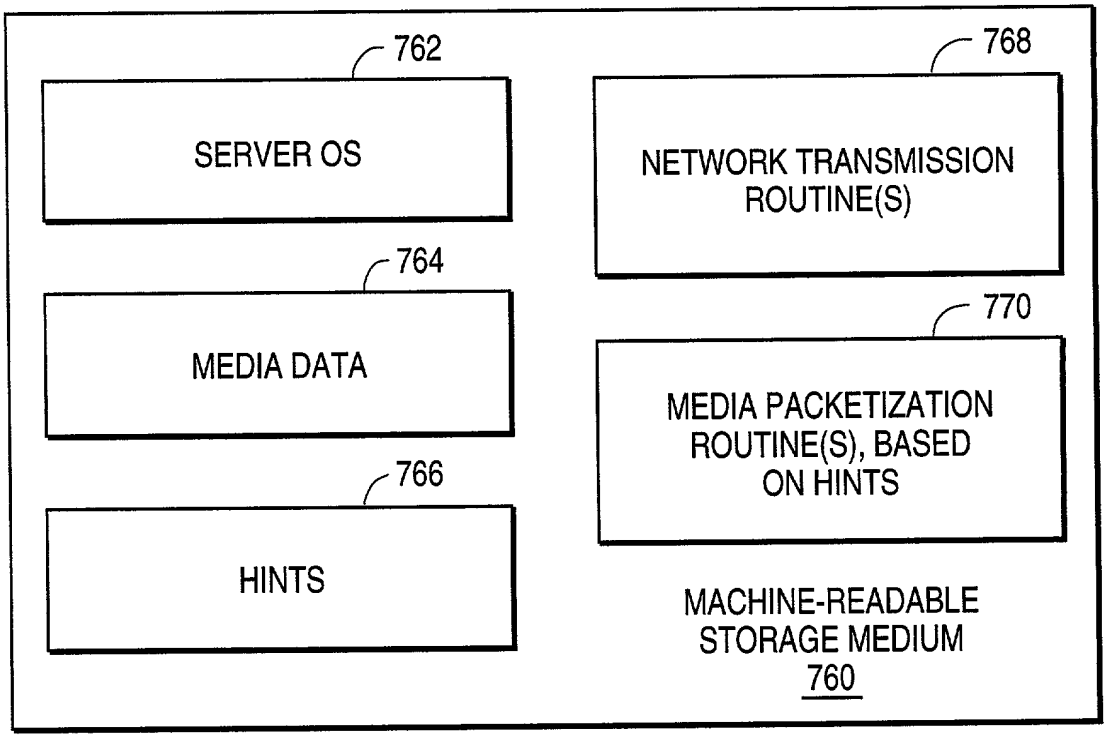

762
SERVER OS
768
NETWORK TRANSMISSION ROUTINE(S)
764
MEDIA DATA
770
MEDIA PACKETIZATION ROUTINE(S), BASED ON HINTS
766
HINTS
MACHINE-READABLE STORAGE MEDIUM
760

FIG. 13

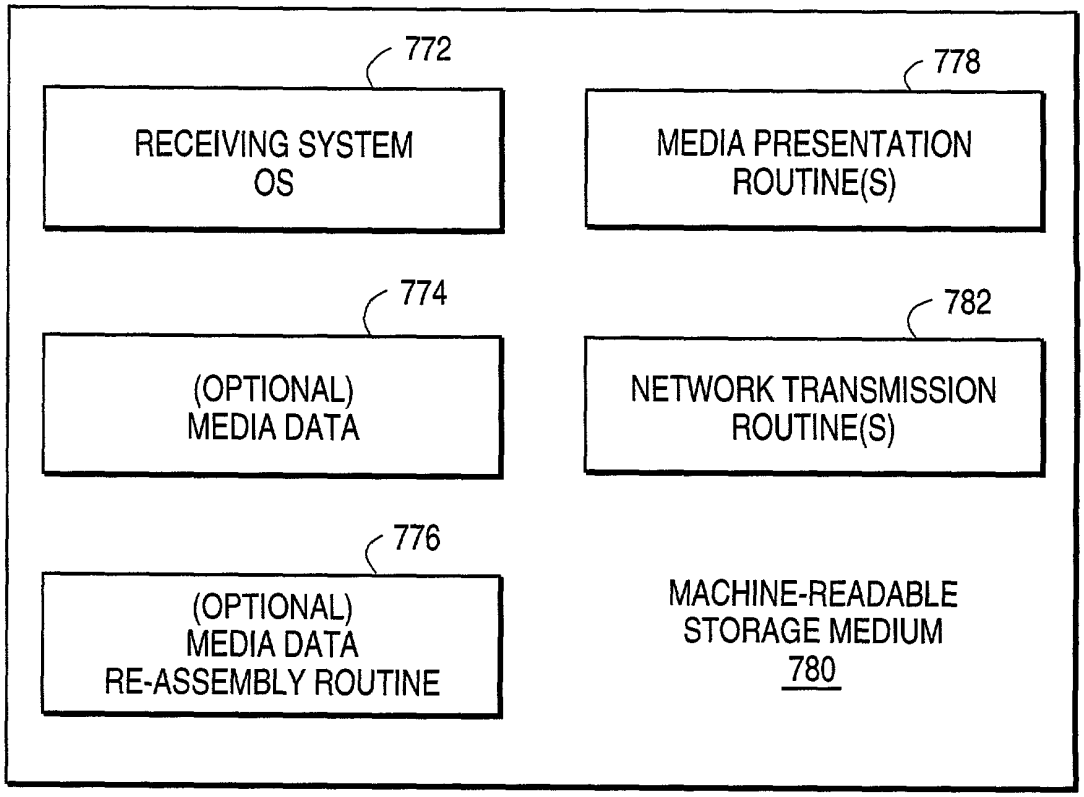

772
RECEIVING SYSTEM OS
778
MEDIA PRESENTATION ROUTINE(S)
774
(OPTIONAL) MEDIA DATA
782
NETWORK TRANSMISSION ROUTINE(S)
776
(OPTIONAL) MEDIA DATA RE-ASSEMBLY ROUTINE
MACHINE-READABLE STORAGE MEDIUM
780

FIG. 14

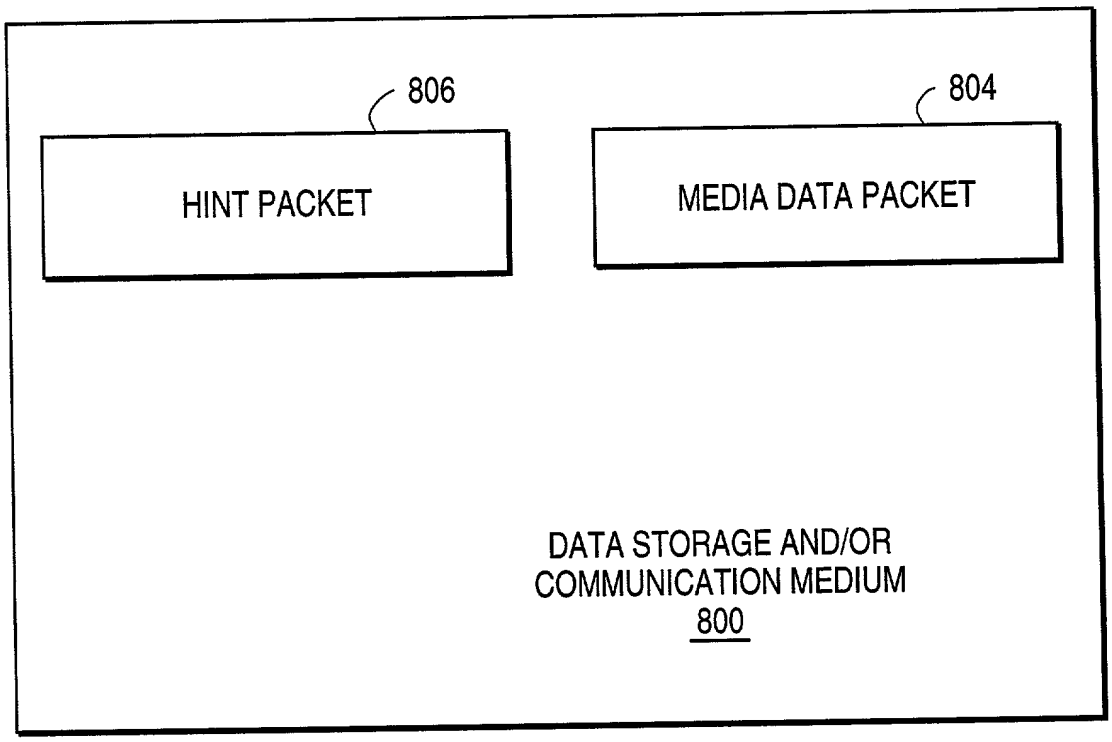

806
804
HINT PACKET
MEDIA DATA PACKET
DATA STORAGE AND/OR
COMMUNICATION MEDIUM
800

FIG. 15

Attorney's Docket No.: 04860.P2207X PATENT

DECLARATION AND POWER OF ATTORNEY FOR PATENT APPLICATION
(CONTINUATION-IN-PART)

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below, next to my name.

I believe I am the original, first, and sole inventor (if only one name is listed below) or an original, first, and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

METHOD AND APPARATUS FOR MEDIA DATA TRANSMISSION

the specification of which

_____ is attached hereto.
_X_ was filed on August 25, 1998 as
United States Application Number 09/140,173
or PCT International Application Number _____
and was amended on _____.
(if applicable)

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, Section 119(a)-(d), of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Prior Foreign Application(s)			Priority Claimed	
(Number)	(Country)	(Day/Month/Year Filed)	Yes	No
(Number)	(Country)	(Day/Month/Year Filed)	Yes	No
(Number)	(Country)	(Day/Month/Year Filed)	Yes	No

I hereby claim the benefit under title 35, United States Code, Section 119(e) of any United States provisional application(s) listed below

60/071,566	January 15, 1998
(Application Number)	Filing Date
(Application Number)	Filing Date

I hereby claim the benefit under Title 35, United States Code, Section 120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, Section 112, I acknowledge the duty to disclose all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application:

(Application Number)	Filing Date	(Status -- patented, pending, abandoned)
(Application Number)	Filing Date	(Status -- patented, pending, abandoned)

I hereby appoint Farzad E. Amini, Reg. No. P42,261; Aloysius T. C. AuYeung, Reg. No. 35,432; Amy M. Armstrong, Reg. No. P42,265; William Thomas Babbitt, Reg. No. 39,591; Carol F. Barry, Reg. No. P41,600; Jordan Michael Becker, Reg. No. 39,602; Bradley J. Bereznak, Reg. No. 33,474; Michael A. Bernadicou, Reg. No. 35,934; Roger W. Blakely, Jr., Reg. No. 25,831; Gregory D. Caldwell, Reg. No. 39,926; Kent M. Chen, Reg. No. 39,630; Lawrence M. Cho, Reg. No. 39,942; Yong S. Choi, Reg. No. P43,324; Thomas M. Coester, Reg. No. 39,637; Roland B. Cortes, Reg. No. 39,152; Barbara Bokanov Courtney, Reg. No. P42,442; Michael Anthony DeSanctis, Reg. No. 39,957; Daniel M. De Vos, Reg. No. 37,813; Tarek N. Fahmi, Reg. No. 41,402; James Y. Go, Reg. No. 40,621; Richard Leon Gregory, Jr., P42,607; Dinu Gruia, Reg. No. P42,996; David R. Halvorson, Reg. No. 33,395; Thomas A. Hassing, Reg. No. 36,159; Phuong-Quan Hoang, P41,839; Willmore F. Holbrow III, Reg. No. P41,845; George W Hoover II, Reg. No. 32,992; Eric S. Hyman, Reg. No. 30,139; Dag H. Johansen, Reg. No. 36,172; William W. Kidd, Reg. No. 31,772; Tim L. Kitchen, Reg. No. P41,900; Michael J. Mallie, Reg. No. 36,591; Andre L. Marais, under 37 C.F.R. § 10.9(b); Paul A. Mendonsa, Reg. No. P42,879; Darren J. Milliken, P42,004; Thinh V. Nguyen, P42,034; Kimberley G. Nobles, Reg. No. 38,255; Michael A. Proksch, Reg. No. P43,021; Babak Redjaian, P42,096; James H. Salter, Reg. No. 35,668; William W. Schaal, Reg. No. 39,018; James C. Scheller, Reg. No. 31,195; Anand Sethuraman, Reg. No. P43,351; Charles E. Shemwell, Reg. No. 40,171; Maria McCormack Sobrino, Reg. No. 31,639; Stanley W. Sokoloff, Reg. No. 25,128; Allan T. Sponseller, Reg. No. 38,318; Geoffrey T. Staniford, P43,151; Judith A. Szepesi, Reg. No. 39,393; Vincent P. Tassinari, Reg. No. P42,179; Edwin H. Taylor, Reg. No. 25,129; George G. C. Tseng, Reg. No. 41,355; Lester J. Vincent, Reg. No. 31,460; John Patrick Ward, Reg. No. 40,216; Stephen Warhola, Reg. No. P43,237; Ben J. Yorks, Reg. No. 33,609; and Norman Zafman, Reg. No. 26,250; my attorneys; and Robert Andrew Diehl, Reg. No. 40,992; my patent agent, of BLAKELY, SOKOLOFF, TAYLOR & ZAFMAN LLP, with offices located at 12400 Wilshire Boulevard, 7th Floor, Los Angeles, California 90025, telephone (310) 207-3800; and James R. Thein, Reg. No. 31,710, my patent attorney; with full power of substitution and revocation, to prosecute this application and

to transact all business in the Patent and Trademark Office connected herewith. I also hereby appoint Mark Aaker, Reg. No. 32,667; Richard Liu, Reg. No. 34,377; Helene Plotka Workman, Reg. No. 35,981; Edward W. Scott, IV, Reg. No. 36,000; and Nancy R. Simon, Reg. No. 36,930; my attorneys; of APPLE COMPUTER, INC., located at 1 Infinite Loop, MS: 38-PAT, Cupertino, California 95014, telephone (408)974-9453, with full power of substitution and revocation, to prosecute this application and to transact all business in the Patent and Trademark Office connected herewith.

Send correspondence to James C. Scheller, Jr., BLAKELY, SOKOLOFF, TAYLOR & ZAFMAN LLP, 12400 Wilshire Boulevard, 7th Floor, Los Angeles, California 90025 and direct telephone calls to James C. Scheller, Jr., (408) 720-8598.
(Name of Attorney or Agent)

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Full Name of Sole/First Inventor Anne Jones

Inventor's Signature _____ Date 1/25/99

Residence Redwood City, California (City, State) Citizenship United States (Country)

Post Office Address 3817 Hamilton Way
Redwood City, CA 94062

Full Name of Second/Joint Inventor Jay Geagan

Inventor's Signature _____ Date 1999/01/25

Residence San Jose, California (City, State) Citizenship United States (Country)

Post Office Address 5475 Prospect Road #212
San Jose, CA 95129

Full Name of Third/Joint Inventor Kevin L. Gong

Inventor's Signature _____ Date 1/25/99

Residence Sunnyvale, California (City, State) Citizenship United States (Country)

Post Office Address 955 Escalon Avenue #515
Sunnyvale, CA 94086

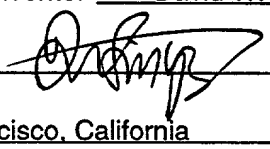
Full Name of Fourth/Joint Inventor Alagu Periyannan

Inventor's Signature _____ Date _____

Residence Fremont, California (City, State) Citizenship India (Country)

Post Office Address 34113 Finnigan Terrace
Fremont, CA 94555

Full Name of Fifth/Joint Inventor David W. Singer

Inventor's Signature  Date 25 jan'99

Residence San Francisco, California (City, State) Citizenship United Kingdom (Country)

Post Office Address 268 Wawona Street
San Francisco, CA 94127

Title 37, Code of Federal Regulations, Section 1.56
Duty to Disclose Information Material to Patentability

(a) A patent by its very nature is affected with a public interest. The public interest is best served, and the most effective patent examination occurs when, at the time an application is being examined, the Office is aware of and evaluates the teachings of all information material to patentability. Each individual associated with the filing and prosecution of a patent application has a duty of candor and good faith in dealing with the Office, which includes a duty to disclose to the Office all information known to that individual to be material to patentability as defined in this section. The duty to disclosure information exists with respect to each pending claim until the claim is cancelled or withdrawn from consideration, or the application becomes abandoned. Information material to the patentability of a claim that is cancelled or withdrawn from consideration need not be submitted if the information is not material to the patentability of any claim remaining under consideration in the application. There is no duty to submit information which is not material to the patentability of any existing claim. The duty to disclosure all information known to be material to patentability is deemed to be satisfied if all information known to be material to patentability of any claim issued in a patent was cited by the Office or submitted to the Office in the manner prescribed by §§1.97(b)-(d) and 1.98. However, no patent will be granted on an application in connection with which fraud on the Office was practiced or attempted or the duty of disclosure was violated through bad faith or intentional misconduct. The Office encourages applicants to carefully examine:

(1) Prior art cited in search reports of a foreign patent office in a counterpart application, and

(2) The closest information over which individuals associated with the filing or prosecution of a patent application believe any pending claim patentably defines, to make sure that any material information contained therein is disclosed to the Office.

(b) Under this section, information is material to patentability when it is not cumulative to information already of record or being made or record in the application, and

(1) It establishes, by itself or in combination with other information, a prima facie case of unpatentability of a claim; or

(2) It refutes, or is inconsistent with, a position the applicant takes in:

(i) Opposing an argument of unpatentability relied on by the Office, or

(ii) Asserting an argument of patentability.

A prima facie case of unpatentability is established when the information compels a conclusion that a claim is unpatentable under the preponderance of evidence, burden-of-proof standard, giving each term in the claim its broadest reasonable construction consistent with the specification, and before any consideration is given to evidence which may be submitted in an attempt to establish a contrary conclusion of patentability.

(c) Individuals associated with the filing or prosecution of a patent application within the meaning of this section are:

(1) Each inventor named in the application;

(2) Each attorney or agent who prepares or prosecutes the application; and

(3) Every other person who is substantively involved in the preparation or prosecution of the application and who is associated with the inventor, with the assignee or with anyone to whom there is an obligation to assign the application.

(d) Individuals other than the attorney, agent or inventor may comply with this section by disclosing information to the attorney, agent, or inventor.

Attorney's Docket No.: 04860.P2207X PATENT

DECLARATION AND POWER OF ATTORNEY FOR PATENT APPLICATION
(CONTINUATION-IN-PART)

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below, next to my name.

I believe I am the original, first, and sole inventor (if only one name is listed below) or an original, first, and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

METHOD AND APPARATUS FOR MEDIA DATA TRANSMISSION

the specification of which

_____ is attached hereto.
_X_ was filed on August 25, 1998 as
United States Application Number 09/140,173
or PCT International Application Number _____
and was amended on _____.
(if applicable)

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

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60/071,566	January 15, 1998
(Application Number)	Filing Date
(Application Number)	Filing Date

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I hereby appoint Farzad E. Amini, Reg. No. P42,261; Aloysius T. C. AuYeung, Reg. No. 35,432; Amy M. Armstrong, Reg. No. P42,265; William Thomas Babbitt, Reg. No. 39,591; Carol F. Barry, Reg. No. P41,600; Jordan Michael Becker, Reg. No. 39,602; Bradley J. Bereznak, Reg. No. 33,474; Michael A. Bernadicou, Reg. No. 35,934; Roger W. Blakely, Jr., Reg. No. 25,831; Gregory D. Caldwell, Reg. No. 39,926; Kent M. Chen, Reg. No. 39,630; Lawrence M. Cho, Reg. No. 39,942; Yong S. Choi, Reg. No. P43,324; Thomas M. Coester, Reg. No. 39,637; Roland B. Cortes, Reg. No. 39,152; Barbara Bokanov Courtney, Reg. No. P42,442; Michael Anthony DeSanctis, Reg. No. 39,957; Daniel M. De Vos, Reg. No. 37,813; Tarek N. Fahmi, Reg. No. 41,402; James Y. Go, Reg. No. 40,621; Richard Leon Gregory, Jr., P42,607; Dinu Gruia, Reg. No. P42,996; David R. Halvorson, Reg. No. 33,395; Thomas A. Hassing, Reg. No. 36,159; Phuong-Quan Hoang, P41,839; Willmore F. Holbrow III, Reg. No. P41,845; George W Hoover II, Reg. No. 32,992; Eric S. Hyman, Reg. No. 30,139; Dag H. Johansen, Reg. No. 36,172; William W. Kidd, Reg. No. 31,772; Tim L. Kitchen, Reg. No. P41,900; Michael J. Mallie, Reg. No. 36,591; Andre L. Marais, under 37 C.F.R. § 10.9(b); Paul A. Mendonsa, Reg. No. P42,879; Darren J. Milliken, P42,004; Thinh V. Nguyen, P42,034; Kimberley G. Nobles, Reg. No. 38,255; Michael A. Proksch, Reg. No. P43,021; Babak Redjaian, P42,096; James H. Salter, Reg. No. 35,668; William W. Schaal, Reg. No. 39,018; James C. Scheller, Reg. No. 31,195; Anand Sethuraman, Reg. No. P43,351; Charles E. Shemwell, Reg. No. 40,171; Maria McCormack Sobrino, Reg. No. 31,639; Stanley W. Sokoloff, Reg. No. 25,128; Allan T. Sponseller, Reg. No. 38,318; Geoffrey T. Staniford, P43,151; Judith A. Szepesi, Reg. No. 39,393; Vincent P. Tassinari, Reg. No. P42,179; Edwin H. Taylor, Reg. No. 25,129; George G. C. Tseng, Reg. No. 41,355; Lester J. Vincent, Reg. No. 31,460; John Patrick Ward, Reg. No. 40,216; Stephen Warhola, Reg. No. P43,237; Ben J. Yorks, Reg. No. 33,609; and Norman Zafman, Reg. No. 26,250; my attorneys; and Robert Andrew Diehl, Reg. No. 40,992; my patent agent, of BLAKELY, SOKOLOFF, TAYLOR & ZAFMAN LLP, with offices located at 12400 Wilshire Boulevard, 7th Floor, Los Angeles, California 90025, telephone (310) 207-3800; and James R. Thein, Reg. No. 31,710, my patent attorney; with full power of substitution and revocation, to prosecute this application and

to transact all business in the Patent and Trademark Office connected herewith. I also hereby appoint Mark Aaker, Reg. No. 32,667; Richard Liu, Reg. No. 34,377; Helene Plotka Workman, Reg. No. 35,981; Edward W. Scott, IV, Reg. No. 36,000; and Nancy R. Simon, Reg. No. 36,930; my attorneys; of APPLE COMPUTER, INC., located at 1 Infinite Loop, MS: 38-PAT, Cupertino, California 95014, telephone (408)974-9453, with full power of substitution and revocation, to prosecute this application and to transact all business in the Patent and Trademark Office connected herewith.

Send correspondence to James C. Scheller, Jr., BLAKELY, SOKOLOFF, TAYLOR & (Name of Attorney or Agent)
ZAFMAN LLP, 12400 Wilshire Boulevard, 7th Floor, Los Angeles, California 90025 and direct telephone calls to James C. Scheller, Jr., (408) 720-8598. (Name of Attorney or Agent)

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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Title 37, Code of Federal Regulations, Section 1.56
Duty to Disclose Information Material to Patentability

(a) A patent by its very nature is affected with a public interest. The public interest is best served, and the most effective patent examination occurs when, at the time an application is being examined, the Office is aware of and evaluates the teachings of all information material to patentability. Each individual associated with the filing and prosecution of a patent application has a duty of candor and good faith in dealing with the Office, which includes a duty to disclose to the Office all information known to that individual to be material to patentability as defined in this section. The duty to disclosure information exists with respect to each pending claim until the claim is cancelled or withdrawn from consideration, or the application becomes abandoned. Information material to the patentability of a claim that is cancelled or withdrawn from consideration need not be submitted if the information is not material to the patentability of any claim remaining under consideration in the application. There is no duty to submit information which is not material to the patentability of any existing claim. The duty to disclosure all information known to be material to patentability is deemed to be satisfied if all information known to be material to patentability of any claim issued in a patent was cited by the Office or submitted to the Office in the manner prescribed by §§1.97(b)-(d) and 1.98. However, no patent will be granted on an application in connection with which fraud on the Office was practiced or attempted or the duty of disclosure was violated through bad faith or intentional misconduct. The Office encourages applicants to carefully examine:

(1) Prior art cited in search reports of a foreign patent office in a counterpart application, and

(2) The closest information over which individuals associated with the filing or prosecution of a patent application believe any pending claim patentably defines, to make sure that any material information contained therein is disclosed to the Office.

(b) Under this section, information is material to patentability when it is not cumulative to information already of record or being made or record in the application, and

(1) It establishes, by itself or in combination with other information, a prima facie case of unpatentability of a claim; or

(2) It refutes, or is inconsistent with, a position the applicant takes in:

(i) Opposing an argument of unpatentability relied on by the Office, or

(ii) Asserting an argument of patentability.

A prima facie case of unpatentability is established when the information compels a conclusion that a claim is unpatentable under the preponderance of evidence, burden-of-proof standard, giving each term in the claim its broadest reasonable construction consistent with the specification, and before any consideration is given to evidence which may be submitted in an attempt to establish a contrary conclusion of patentability.

(c) Individuals associated with the filing or prosecution of a patent application within the meaning of this section are:

(1) Each inventor named in the application;

(2) Each attorney or agent who prepares or prosecutes the application; and

(3) Every other person who is substantively involved in the preparation or prosecution of the application and who is associated with the inventor, with the assignee or with anyone to whom there is an obligation to assign the application.

(d) Individuals other than the attorney, agent or inventor may comply with this section by disclosing information to the attorney, agent, or inventor.

Attorney's Docket No.: 04860.P2207 Patent

DECLARATION AND POWER OF ATTORNEY FOR PATENT APPLICATION

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below, next to my name.

I believe I am the original, first, and sole inventor (if only one name is listed below) or an original, first, and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

METHOD AND APPARATUS FOR MEDIA DATA TRANSMISSION

the specification of which

___X___ is attached hereto.

_____ was filed on _____ as United States Application Number _____ or PCT International Application Number _____ and was amended on _____. (if applicable)

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claim(s), as amended by any amendment referred to above. I do not know and do not believe that the claimed invention was ever known or used in the United States of America before my invention thereof, or patented or described in any printed publication in any country before my invention thereof or more than one year prior to this application, that the same was not in public use or on sale in the United States of America more than one year prior to this application, and that the invention has not been patented or made the subject of an inventor's certificate issued before the date of this application in any country foreign to the United States of America on an application filed by me or my legal representatives or assigns more than twelve months (for a utility patent application) or six months (for a design patent application) prior to this application.

I acknowledge the duty to disclose all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, Section 119(a)-(d), of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Prior Foreign Application(s)			Priority Claimed	
(Number)	(Country)	(Day/Month/Year Filed)	Yes	No
(Number)	(Country)	(Day/Month/Year Filed)	Yes	No
(Number)	(Country)	(Day/Month/Year Filed)	Yes	No

I hereby claim the benefit under title 35, United States Code, Section 119(e) of any United States provisional application(s) listed below

60/071,566	January 15, 1998
(Application Number)	Filing Date
(Application Number)	Filing Date

I hereby claim the benefit under Title 35, United States Code, Section 120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, Section 112, I acknowledge the duty to disclose all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application:

(Application Number)	Filing Date	(Status -- patented, pending, abandoned)
(Application Number)	Filing Date	(Status -- patented, pending, abandoned)

I hereby appoint Aloysius T. C. AuYeung, Reg. No. 35,432; William Thomas Babbitt, Reg. No. 39,591; Jordan Michael Becker, Reg. No. 39,602; Bradley J. Bereznak, Reg. No. 33,474; Michael A. Bernadicou, Reg. No. 35,934; Roger W. Blakely, Jr., Reg. No. 25,831; Gregory D. Caldwell, Reg. No. 39,926; Kent M. Chen, Reg. No. 39,630; Lawrence M. Cho, Reg. No. 39,942; Thomas M. Coester, Reg. No. 39,637; Roland B. Cortes, Reg. No. 39,152; William Donald Davis, Reg. No. 38,428; Michael Anthony DeSanctis, Reg. No. 39,957; Daniel M. De Vos, Reg. No. 37,813; Tarek N. Fahmi, Reg. No. 41,402; James Y. Go, Reg. No. 40,621; Sharmini Nathan Green, Reg. No. 41,410; David R. Halvorson, Reg. No. 33,395; Eric Ho, Reg. No. 39,711; George W Hoover II, Reg. No. 32,992; Eric S. Hyman, Reg. No. 30,139; Dag H. Johansen, Reg. No. 36,172; Stephen L. King, Reg. No. 19,180; Michael J. Mallie, Reg. No. 36,591; Kimberley G. Nobles, Reg. No. 38,255; Ronald W. Reagin, Reg. No. 20,340; James H. Salter, Reg. No. 35,668; William W. Schaal, Reg. No. 39,018; James C. Scheller, Reg. No. 31,195; Charles E. Shemwell, Reg. No. 40,171; Maria McCormack Sobrino, Reg. No. 31,639; Stanley W. Sokoloff, Reg. No. 25,128; Allan T. Sponseller, Reg. No. 38,318; Steven R. Sponseller, Reg. No. 39,384; Judith A. Szepesi, Reg. No. 39,393; Edwin H. Taylor, Reg. No. 25,129; George G. C. Tseng, Reg. No. 41,355; Lester J. Vincent, Reg. No. 31,460; John Patrick Ward, Reg. No. 40,216; Ben J. Yorks, Reg. No. 33,609; and Norman Zafman, Reg. No. 26,250; my attorneys; and Robert Andrew Diehl, Reg. No. 40,992; Thomas A. Hassing, Reg. No. 36,159; and Edwin A. Sloane, Reg. No. 34,728; my patent agents, of BLAKELY, SOKOLOFF, TAYLOR & ZAFMAN, with offices located at 12400 Wilshire Boulevard, 7th Floor, Los Angeles, California 90025, telephone (310) 207-3800; and James R. Thein, Reg. No. 31,710, my patent attorney; with full power of substitution and revocation, to prosecute this application and to transact all business in the Patent and Trademark Office connected herewith. I also hereby appoint Mark Aaker, Reg. No. 32,667, Paul D. Carmichael, Reg. No. 18,679; Richard Liu, Reg. No. 34,377; Helene Plotka Workman, Reg. No. 35,981; Edward W. Scott, IV, Reg. No. 36,000; and Nancy R. Simon, Reg. No. 36,930; my attorneys; of APPLE COMPUTER, INC., located at 1 Infinite Loop, MS: 38-PAT, Cupertino, California 95014, telephone (408)974-9453, with full power of substitution and revocation, to prosecute this application and to transact all business in the Patent and Trademark Office connected herewith.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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